September 1961

Agriculture

Volume 68 Number 6

Seed identification

Published for the Ministry of Agriculture, Fisheries and Food
by Her Majesty's Stationery Office

ONE SHILLING MONTHLY


F C
120 50
100 40
80 30
60 20
40 10
32 0
20 10


QUALITY
PAULS

Agriculture

Volume 68 Number 6 September 1961

EDITORIAL OFFICES
THE MINISTRY OF AGRICULTURE, FISHERIES AND FOOD
WHITEHALL PLACE · LONDON S.W.1 · TRAFALGAR 7711

CONTENTS

Cover Photograph: A reference collection and microscope are required for seed identification. Photo: N.I.A.B.

Winter Grass

H. K. BAKER, B.Sc., Ph.D., Dip. Agric., and J. R. A. CHARD, N.D.A.
Grassland Research Institute, Hurley, Berks
and
G. PEARSON HUGHES, B.Sc.
National Agricultural Advisory Service, Cambridge

EXPERIMENTAL work at the Grassland Research Institute and Research Centres in Scotland has indicated that grass grown during the late summer and early autumn can be conserved successfully *in situ* for grazing during winter by beef cattle.[1,2] To test the possibility of growing and using this "winter grass" under a wide range of conditions, joint Grassland Research Institute/National Agricultural Advisory Service trials were carried out on commercial farms throughout England and Wales from 1954 to 1960. The value of this system was tested at 65 sites on soils ranging from light sands to heavy clays: they had wide variations in climate, particularly in rainfall and temperature.

Type of sward

The swards used in these experiments were mostly cocksfoot-dominant grass and white clover mixtures. However, at some centres the cocksfoot was grown in drills 12–24 in. apart, either alone (for seed production) or in alternate drills with lucerne. In mild, wet autumns, cocksfoot may be attacked by various fungi. Apart from the influence this has on nutritive value and on subsequent losses in yield as a result of rotting, the infected herbage is unpalatable to stock and is therefore badly utilized. Cocksfoot grown in wide drills is less affected by rotting than it is in close swards, presumably because the erect growth of the plants, and distance between rows, allows a better circulation of air within the sward and keeps the herbage drier than in the dense conditions of a normal sward. Herbage yields of cocksfoot/clover swards are higher in the autumn than those of cocksfoot grown in wide drills. However, in the south, the herbage losses due to rotting are greater in the case of the former, and after Christmas higher yields of better quality material are generally obtained from wide rows. In the north there is less danger of fungal infections (maybe because of the colder climate) and in such locations there seems no particular advantage in growing cocksfoot in wide rows.

Management

The earlier swards are rested, the higher are the yields of "winter grass"; the lower the quality of the herbage, the greater the susceptibility to "winter-burn" and the poorer the palatability. Furthermore, nitrogen applied during the late summer has a marked effect on the autumn growth of grasses, so that

there are various combinations of resting dates and levels of nitrogen application for the production of a good yield of herbage for winter grazing. Generally the optimum treatment for a cocksfoot sward is to rest it from mid-August, when 50-60 lb per acre of nitrogen should be applied. This gives the best compromise of yield and quality and on average will result in 15 cwt per acre of dry matter for grazing in November or December. Local conditions affect the resting date, and the date should generally be advanced by 7-10 days in the colder districts of the north and delayed by 7-10 days in the south west.

Utilization

In these experiments, the swards were grazed at various times from November to February. During this period swards may be damaged by poaching. Experiments at Drayton[1] and elsewhere, have shown that cocksfoot, grown in drills 24 in. apart, was resistant to treading, even on heavy, clay soils and in wet seasons. On grass/clover swards, controlled grazing reduces damage from poaching, and generally the wetter the conditions the stricter this control should be. The greatest damage is done when a small number of stock have access to large areas for long periods; appreciable quantities of herbage will then be affected by treading and soiling. This makes it unattractive to stock, so that they spend more time wandering around looking for fresh herbage and do even more damage.

A single grazing during the winter will not reduce the amount and earliness of spring growth from a sward. However, grazing the regrowth, which occurs within 7–10 days of defoliation, will weaken the plants and result in a poorer growth the following spring. This is another reason for not allowing stock to stay on the same area for long periods. Quick grazing ensures that herbage is utilized better, reduces the amount of damage from poaching and prevents the weakening of the grass plants.

Good results have been obtained with beef cattle by using paddocks each of which provides sufficient keep for 5-7 days. Dairy cattle have successfully strip-grazed winter grass, but a back fence is essential. Cattle graze very selectively on winter grass, and the herbage left after a period of grazing is normally of very low feeding value. If productive stock are being used for grazing, one should accept a certain amount of wastage rather than force the stock to clear up all the herbage. Store animals may be used to clear up after the productive animals.

Animal production

These results have confirmed that beef animals can be kept exclusively on winter grass. One acre normally provides 4-6 weeks grazing for one 18-month-old bullock, and liveweight gains of 1-1½ lb per day may be obtained up to Christmas. After this the grass deteriorates in quality and, unless supplementary feeding is adopted, the animals may lose weight. Dairy cows have grazed the grass well during November/December and from 1 to 3½ gallons of milk per cow per day has been produced from winter grass. This grass tends to be low in soluble carbohydrates and can be balanced by a starch supplement.

Grass species

Cocksfoot is a suitable species for winter grass production, because it grows well in the autumn and its erect habit of growth makes it particularly suitable for grazing during the wet conditions of early winter. Under most conditions, S.143 is the most suitable variety of cocksfoot, particularly because of its relatively strong resistance to frost damage and ability to stay "winter-green" for a longer period than other cocksfoot varieties. Tall fescue is also valuable for winter grass production[3] and it has the further advantage of growing extremely early in the spring. A further series of joint trials is comparing cocksfoot/white clover leys with tall fescue/meadow fescue/white clover leys. The tall fescue is slower to establish, but autumn resting encourages its subsequent development, and its production tends to increase with successive harvest years. White clover persists more readily with it, and summer grazing encourages the tall fescue to tiller, with beneficial effects on the following yield of winter grass. Summer production from the fescue mixture (conserved or grazed), compares favourably with that from cocksfoot, and there has been no difficulty in getting stock to graze tall fescue, provided it is not allowed to become too mature. During the autumn the fescue and cocksfoot mixtures produce similar quantities of herbage, but during the early winter, cocksfoot "burns" more quickly and becomes inferior both in quality and in palatability. In spring, the tall fescue grows away very rapidly and produces an earlier bite than cocksfoot. The new forms of tall fescue originating from North Africa and now under intensive test in this country seem most promising, and if the early promise is fulfilled then the balance in favour of tall fescue as a winter grass will be much more emphatic.

It is important to note that autumn rainfall has a marked effect on the production of winter grass. Dry weather results in smaller quantities of higher quality grass, and this is better utilized by stock than the lusher growth produced in wet autumns. It will not, however, keep the stock for such a long period and, as in all cases when planning for out-of-season production, due allowance must be made for an adequate supply of reserve feeds.

References

1. Hughes, G. Pearson (1954). The production and utilization of winter grass. *J. Agri. Sci.*, **45**, No. 2, 179-201.
2. Corbett J. L. (1957). Studies on the extension of the grazing season. I. The evaluation of selected strains of some grass species for winter grazing. *J. Brit. Grassl. Soc.*, **12**, No. 2, 81-96.
3. Hughes, G. Pearson (1955). Tall fescue and lucerne drills for winter and summer grass. *J. Brit. Grassl. Soc.*, **10**, No. 2, 135-8.

Veal Production

K. W. G. SHILLAM, B.Sc., Dip. Agric., Ph.D.
National Institute for Research in Dairying

This article is based on a paper read by Dr. Shillam at the thirty-fourth meeting of the British Society of Animal Production in March.

INTEREST in veal production in the United Kingdom has undoubtedly arisen as a result of imports from Holland of high quality veal carcasses and milk substitute diets. These specially-developed high-energy milk substitutes have enabled the production of veal in Holland to be placed on a sound economic basis; the net profit to the veal producers in 1960 was estimated at £4 million.

Much of our home-produced veal has, for some time, been from surplus calves that are slaughtered soon after birth. However, it is probable that the increasing number of calves being reared, especially in the south of England, for the quality veal trade largely accounts for the increase in production last year of 37 per cent over that in 1959. Even so, consumption is still only two-thirds that of pre-war—a time when milk-fed veal was available—and if veal can compete in price with other forms of meat, the demand should continue to rise.

Requirements of the veal trade

In the first instance, the veal carcass must be very well fleshed. Success therefore obviously depends on a high rate of liveweight gain with a complete absence of any setbacks to growth. If these aims cannot be achieved the carcass will contain a high ratio of bone to flesh, and will not carry the thin layer of fat over the rump, back and shoulders necessary to give the "finished" appearance. Further, the producer may also have to contend with an increased food conversion ratio, and with extra overhead and food costs as a result of having to maintain the calf over a longer period. The aim should be an average of at least 2 lb a day throughout the vealing period, with as much as 2½-3 lb a day in the later stages. As digestive upsets are more easily caused in the early stages of the fattening period, it pays to restrict intake so that the calf gains only about 1 lb a day during the first 10 days of life.

The largest single factor at present determining the price paid to the producer appears to be the so-called whiteness of the flesh, and here little can be done except perhaps to ensure that the calf is not allowed access to unlimited supplies of iron from parts such as rusty bucket rings and gates, or from solid foods such as concentrates. The desire for "white" flesh is not, apparently, based on cooking quality, taste or tenderness. In fact, experiments in Wisconsin have shown that supplements of iron and copper given to milk-fed calves produce a more tender veal. Whiteness seems to be of value only in that it gives the meat an attractive appearance and shows the consumer that the joint is from a milk-fed veal calf, and not from an indifferently reared animal.

Calves should be slaughtered as soon as the correct finish is obtained, and with the Ayrshire and Shorthorn breeds we slaughter at about 260 lb live weight, which gives a 160 lb carcass. With the larger-boned Friesian, it may be best to slaughter at a slightly heavier weight, say 300 lb. Assuming a birth weight of 80 lb and a mean growth rate of 2 lb a day, the vealing period need be no longer than 13 weeks.

As far as breeds are concerned, the Friesian and the Dairy Shorthorn seem to be particularly suitable; other dual-purpose types and the beef breeds should make good veal, but the high prices often paid in the market for these calves at a few days of age would generally preclude their use for fattening for veal. We have obtained good results with Ayrshires, which seem to fatten readily and have a pale carcass.

Nutrition

To obtain the high liveweight gains, specialized diets of high energy content are being marketed. Most of these milk substitutes consist of about 75 per cent milk by-products, mainly dried skim milk, and 18-20 per cent fat, together with added vitamins and minerals. In general, the fat consists of a mixture of stabilized tallow and lard; lard appears to be the more suitable, but is also the more expensive. The even more expensive vegetable fats are generally considered to give the best results.

As it is usually recommended that the milk substitute should be reconstituted at the 12 to 14 per cent level, the amount of fat in the diet given to the calf is of the order of 2·2 to 2·8 per cent. The fat and its incorporation into the milk powder during manufacture of the milk substitute are expensive items, and the question arises what is the most economic level of fat? As the diet at the levels fed contains more than enough protein for the weight gains required, it is probable that the calf can derive considerable energy from surplus de-aminated protein. For example, in preliminary trials, we have obtained very good growth rates with diets containing only 1·1 per cent fat after reconstitution, and with no other sources of added energy. However, where lard and tallow are used, it is likely that better results would be obtained from a somewhat higher level. At these lower levels of fat the food conversion ratio is increased, but even so, the relative cheapness of the diet probably more than offsets the extra food consumed.

Incorporating the fat into the skim milk

The method whereby the fat is incorporated into the skim milk is of importance, for unless the fat and milk are correctly homogenized or emulsified, the fat globules are large and the utilization of fat by the calf is low. Such diets also tend to cause a high incidence of scouring and loss of hair. Most of the milk substitutes now available are prepared by emulsifying the melted fat into the skim milk powder usually by lecithin or glyceryl monostearate. The alternative is to homogenize the fat into the liquid skim milk and then either roller- or spray-dry the mixture. In general, the smaller the fat globule, the greater is the rate of digestion of fat, and with some vegetable fats at least, homogenization gives a much smaller globule (about 2 microns) than emulsification using soya-bean lecithin (20 or 30 microns). Thus we have found that during the first 3 weeks of life, an homogenized diet gave a significantly better growth rate than diets emulsified with 0·1 or 0·2 per cent

lecithin. A similar result may not, however, be obtained with calves older than this, for by 3 weeks of age, the level of plasma lipids of the calves given emulsified fat had reached that of the calves given the homogenized diet. On a commercial scale, homogenization is probably more costly than emulsification, and also a supply of liquid skim milk must be available. Thus even if homogenization is found generally superior to emulsification, it may be necessary for economic reasons to accept some reduction in utilization of the emulsified fat. It may be, though, that a particular emulsifying agent is more satisfactory with one type of fat than with another, and perhaps, too, commercial firms adopt certain procedures that we have been unable to copy on a laboratory scale.

We are reasonably satisfied on the gross energy requirements for maintenance and gains in weight up to 1 lb a day using a diet of whole milk. Little is known, however, of the efficiency of conversion of the calf when given much larger quantities of milk; neither do we know whether the animal fats are digested and utilized to the same extent as butterfat. Further, most of the estimates of the energy required for maintenance of body weight of the milk-fed calf have been made using young animals of not more than 120-130 lb in weight, and we do not know how far these estimates hold true for the much larger well-fleshed animal, whose body composition differs greatly from that of the smaller and lightly-fleshed calf. Until problems such as these have been solved, recommendations on feeding levels cannot be made with any degree of precision. So far it seems that *ad lib.* feeding may be less economic than a somewhat lower level.

Quality of the milk is important

In the formulation of these milk substitutes it is becoming increasingly evident that the performance of the calf may be affected by the quality of the skim milk powder. In experiments at Shinfield involving over 500 calves, we have obtained considerable evidence to show that during the normal pre-ruminant stage, i.e. in the first 2-3 weeks of life, performance can be related to the heat treatment the milk fraction of the diet has received during manufacture. Skim milk powders reconstituted at the 10 per cent level which contain only 60-85 mg per cent non-casein nitrogen have a detrimental effect, whereas no adverse effects are apparent when the non-casein nitrogen content is 120-140 mg per cent. Denaturation of the non-casein proteins is quite common in roller-dried milks and also occurs in certain spray-dried milks, depending upon the preheat treatment of the liquid milk. Under conditions of low "infection" in the calfhouse the "severely" heated milks cause a marked depression in growth rate, and under conditions of "high infection", a high incidence of scouring and mortality associated generally with *Escherichia coli.* We are continuing these studies with the older milk substitute-fed veal calf.

To prevent any trouble with tetany the compounders should add a small amount of magnesium to the milk substitute whereas it is doubtful if the addition of calcium and phosphorus is necessary. The milk substitutes used in Holland are low in iron; this is because the water, often obtained from wells, is rich in this element. As, however, the water supply in the southern part of England at least appears to contain little or no iron, some should be

added to the milk substitutes used in this country as a safeguard against the development of clinical symptoms of anaemia, particularly where calves are housed in wooden crates.

Addition of the fat-soluble vitamins to the milk substitute is necessary, and it has been claimed that where spring-born calves have low reserves of vitamins A and D at birth owing to poor feeding of the dams, they should be given a large dose of these vitamins over the first few days on the milk substitute.

Antibiotics may be included in milk substitutes used in Holland, and there is a large body of opinion which considers that antibiotics are essential for successful veal production. Their use in this country would probably make veal production more likely to succeed, especially under unfavourable husbandry conditions, provided that there is no danger from strains of organisms developing resistance to antibiotics.

Environmental aspects

The calf growing at a rapid rate on a liquid diet where economy of conversion is of the greatest importance obviously requires more specialized housing than the young herd replacement. Wooden fattening crates with slatted floors and usually with slatted sites, 2 ft wide and 5 ft long, are widely used in Holland and we have likewise found them to be suitable. If the calves are tethered on a short chain, the sides of the crate need only be about 3 ft long. Small groups of calves are claimed to be satisfactory in well-insulated and draught-free buildings, but it may be difficult to remove the dung that accumulates under the slatted floor and prevents urine from draining away. Further, calves kept in groups may develop vices such as sucking navels and drinking urine and, as a result of licking each other, large hairballs may be formed in the rumen.

As young calves are particularly susceptible to scour, in an intensive enterprise they should be kept separate from older calves in the main fattening shed and preferably bedded on straw for the first two weeks of life, or, if bought in, for the first two weeks after purchase. After this time, the use of slatted floors above a sloping concrete floor prevents soiling of the calves. If straw or another form of bedding is used, large quantities are needed daily, as the calves excrete large amounts of urine. With the individual crates, the dung falls close to or directly into a channel at the rear and the urine is not prevented from draining away freely.

There is no evidence whatsoever to show that darkness favours the production of white flesh, and provided direct sunlight is avoided the animals will keep just as quiet and rest in normal light. A temperature of 60-65°F has been suggested as adequate for an efficient conversion of food. To control humidity, the building must be well ventilated without creating draughts, and in large specialized buildings the provision of an extractor fan may be necessary.

Profitability

At the present time, the profitability of a veal enterprise is uncertain, for returns depend not only on quality of the carcass but also on the number of carcasses, both home-produced and imported, on the market at a given time. Under a system involving the use of proprietary milk substitutes, the pro-

ducer needs a return for the carcass of about 3*s*.–3*s*. 2*d*. per lb to cover his costs of production. A limited amount of veal is being marketed through highly specific channels at a price acceptable to the producer, but from the usual markets, such as Smithfield, the net price received by the producer during the last year for good carcasses has not averaged much more than 3*s*. 2*d*. a lb. On occasions, returns have been as high as 3*s*. 8*d*., but in our experience this was usually due to a temporary shortage of veal rather than to superior carcasses. The possibility of exporting carcasses to the Continent, particularly Italy and France, where veal is in greater demand and higher prices are paid, perhaps deserves attention. If, on the other hand, the demand for veal at home expands, there seems a good chance that food costs will be reduced and that proper marketing arrangements with payment for quality will make the system more profitable. The recently formed British Quality Veal Producers' Association could make a large contribution towards achieving this objective. The quick returns of the system are well worth attention and, with a fattening period of 13 weeks, it should be possible to fatten almost four groups of animals in a building in one year.

Rearing calves for veal is not unlike broiler chicken production in that it demands a rapid rate of liveweight gain for a relatively short period of the animal's growing life. Obviously, therefore, both the diet and the environment must be meticulously correct, and I do not think there is any justification for the claims that the commercial diets now available are deliberately deficient in certain nutrients. Further, I believe that the conditions of housing used for efficient veal production need in no way impair the well-being of the animal.

Growth Studies of Beef Calves

T. L. J. Lawrence

and

J. Pearce, Ph.D., Dip. Agric.

A discussion of the early weaning system: its effect on growth rate, conformation and food consumption, and its problems.

A HIGH proportion of calves reared for beef are from dairy herds. Most of these are born in the autumn and early winter, and many are bought for rearing on farms with no readily available supply of whole milk. The early-weaning system is widely used in their rearing, and has many advantages. It allows the rearing of large numbers of calves at a time when they are relatively cheap and, provided that the technique is properly applied few troubles are experienced.

The general technique of early weaning, and the composition of milk substitutes and concentrate mixtures have been adequately covered. On the other hand, comparatively little information is available concerning the growth and development of calves reared on the system in relation to food consumption.

The purpose of this article is to show the kind of progress cross-bred beef calves are likely to make on the early weaning system, and to discuss some of the practical implications of the results of experimental work concerned with growth studies in beef cattle. The 36 calves reared during this investigation were out of Dairy Shorthorn cows by Sussex bulls, and they were later to form the basis of a study of the effect of the level of nutrition on development at the yearling stage. They were all bought at a few days old in the late autumn and winter of 1958-59, and reared in individual pens up to six months of age.

Method of rearing

On arrival, each calf was weighed and given two large tablespoons of glucose in 1½ pints of warm water. No other food was given until the following morning. This initial treatment appeared to overcome many of the problems found when calves have travelled long distances to farms from a variety of sources. In particular it gives a large measure of control over scouring, and the glucose provides a readily available source of energy.

For the remainder of the first week of life, milk substitute was fed at the rate of 4 pints a day in two feeds, and during the next four weeks the level was increased to 5 pints a day. Weaning was carried out abruptly at five weeks of age. Each calf received added vitamins with the home-mixed milk substitute, at the rate of 3,500 International Units of vitamin A and 700 International Units of vitamin D every day. Previous experience had shown that an adequate supply of these vitamins at this time was vital in the rearing of healthy calves.

Concentrates were offered at one week of age, and the intake was not restricted until calves were eating 6 lb per day. For the first ten weeks the following mixture was used:

	per cent
Rolled barley	20
Flaked maize	40
Mollasine meal	10
Dried skim milk powder	10
Linseed cake	14
Fish meal	5
Vitamins A and D	1

At ten weeks old a cheaper ration was introduced so that the complete change-over occurred by the end of the twelfth week. This ration consisted of:

	per cent
Rolled barley	75
Flaked maize	10
Decorticated ground-nut meal	15

(With 3 lb of a mineral mixture for every 100 lb of concentrates)

Hay was also offered *ad lib.* from one week of age, together with free access to a supply of clean water. At no stage was the hay intake restricted.

Liveweight gain

The calves were weighed weekly, and the results in the table on p. 296 indicate that liveweight gain in the pre-weaning period was rather low. This would seem to be characteristic of the early-weaning system, however.

Live weight and liveweight gain at different stages of rearing

	Average live weight of calf lb	Average liveweight gain per calf day lb
At 1 week	86·6	—
At 5 weeks	104·6	—
Gain 1-5 weeks	—	0·6
At 12 weeks	183·7	—
Gain 5-12 weeks	—	1.6
Gain 1-12 weeks	—	1·3
At 26 weeks	336·6	—
Gain 12-26 weeks	—	1.6
Gain 1-26 weeks	—	1·4

The rate of gain increased sharply after weaning, and an average gain of 1·6 lb/day was recorded from weaning up to 3 months of age, many animals reaching 1·8 lb/day and over. The liveweight gain from 3 to 6 months of age was also 1·6 lb/day.

Food consumption

The total consumption of concentrates to 6 months of age averaged approximately 7 cwt per calf. This was made up of rather less than 2 cwt of the first mixture and just over 5 cwt of the second mixture of concentrates. By the time calves were weaned at 5 weeks of age, concentrate consumption averaged approximately 1¼ lb/day. The individual variation between calves was very considerable. At 10 weeks of age, when the concentrate ration was changed, the consumption had risen to an average of 4½ lb/day, and the upper limit of 6 lb/day was generally achieved by the end of the thirteenth week. Once again, however, there was great variation between calves.

Although hay was offered *ad lib.* throughout, consumption over the whole period of 6 months amounted to only 1½ cwt per calf. Over 75 per cent of this total intake of hay occurred in the second 3 months of rearing.

Total food consumption per calf up to 6 months of age

Stage of rearing	*Concentrate consumption per calf lb*	*Hay consumption per calf lb*
First 5 weeks	17·8	6·7
5-12 weeks	197·9	22·0
12-26 weeks	547·5	135.8
1-26 weeks	763·2	164·5

Growth rate and food consumption

Heavier animals at the beginning of rearing tended to grow faster throughout, but this effect was rather small. The weaning weight exerted a greater influence than initial weight on post-weaning gain. Throughout the whole period, faster growth was induced by increasing concentrate consumption. Larger animals at one week of age did tend to consume more concentrates, but the relationship between weaning weight and concentrate consumption

was more pronounced, the heavier animal at weaning eating more concentrates up to 3 months of age. Calves which ate more concentrates also ate more hay, except in the period from weaning to 3 months of age, when increasing concentrate consumption was accompanied by a decreasing consumption of hay.

Hay appeared, however, to be affecting growth rate to only a very small extent; and only before weaning and after 3 months of age did the effect seem to be of any significance. The effect after 3 months is understandable because concentrates were restricted at this time, but it is difficult to account for the effect of hay before weaning. Calves have little ability to digest fibre at this age, and it is possible that the effect recorded was not a true liveweight gain but rather an increased retention of food and thus greater gut fill. This would be reflected in the weight recorded.

The weaning weight, therefore, appeared to be important in determining concentrate consumption and the liveweight gain made after weaning. The study of individual calves, however, suggested that the appetite for concentrates before weaning was just as important in determining post-weaning consumption and growth rate as the weaning weight itself. It seemed that heavier animals grew faster because they could consume more concentrates, and not because they had an inherently greater growth potential as such. In fact, at constant food intake, the smaller animals gained weight faster.

Thus of the three factors affecting growth rate, consumption of concentrates appeared to be of much greater importance than either consumption of hay or size of animal.

Conformation development

During the rearing period of 6 months, body measurements were taken at equal intervals to study the changing pattern of conformation.

Measurements of the height of the animal showed a steady progress throughout the whole period. The gains were small but consistent, with little tendency to slow down in the later stages. On the other hand, the histogram on p. 298 shows that, after weaning, the width and depth of the animal increased more than its height. Nevertheless this rapid development of width and depth was slowing down faster than that of height in the later stages of rearing.

The increase in circumference at the navel was also very considerable after weaning, but here again the rate of development was slowing down towards 6 months of age. There was no indication that the early weaning system had any tendency to produce pot-bellied calves.

Within the extremes of liveweight gain made by individual calves, there was evidently a relationship between weight gain and conformation development. The calves with the poorest weight gains grew in height only slightly slower than the calves with the best gains in weight. Width and depth, however, were much more severely affected, and differences in weight gain between calves of $\frac{1}{2}$ to $\frac{3}{4}$/lb/day showed up clearly in the development of width and depth.

Some practical implications

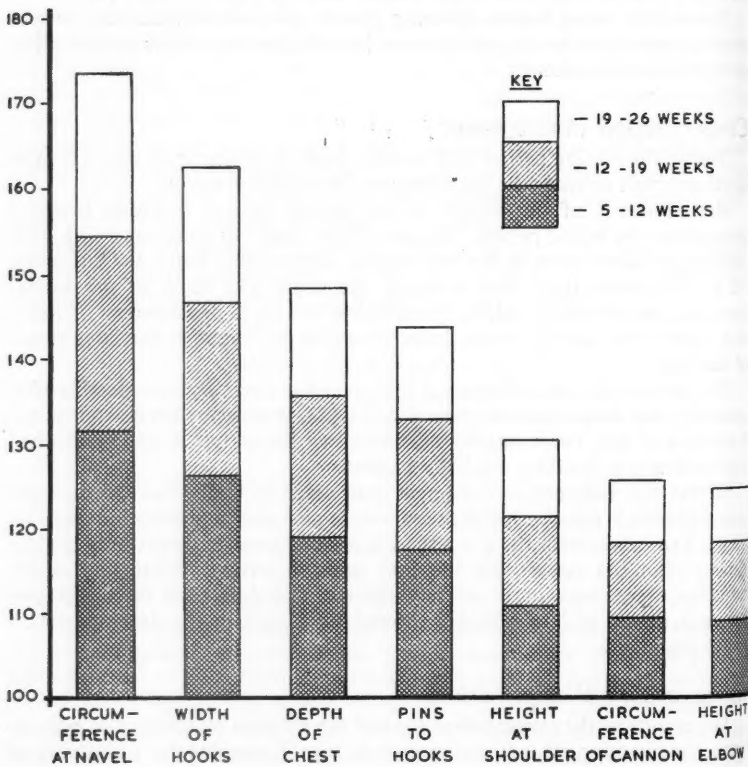
The results of the investigation showed the extreme importance of concentrate consumption in influencing growth rate. Undoubtedly, palatability of

the mixture offered is of paramount importance. Particularly is this so before weaning, when, in spite of near maintenance levels of milk substitute feeding, intake of concentrates was low. This was reflected in the poor rate of live-weight gain. Ensuring that the concentrates put before the calf are always fresh is one way of improving palatibility, but other factors should not be ignored.

The actual mixing of the concentrates should retain the individual physical characteristics of the various constituents used. A fine meal is not very acceptable, but if linseed cake is used then the size of the pieces in the final mixture should not be too large or these will be rejected after chewing over, and they will foul the remaining food. Perhaps using ground-nut meal in place of the linseed cake and increasing the percentage of flaked maize at the expense of some rolled barley could produce a more palatable ration in the early stages.

The importance of the weaning weight leaves doubt as to whether the practice of weaning at a firm age is sound. Weaning at a given weight, or, better still, at a given level of concentrate consumption would give better results.

From the very small intake of hay and its subsequent effect on weight gain there is every reason to doubt the advisability of feeding hay in the early



stages of rearing. The results of other experiments have often shown that the end products of metabolism, rather than the physical nature of the diet, influence rumen development. It might be desirable to restrict hay feeding before 3 months of age, to induce the calf to take more concentrates. Nevertheless, more critical experimental work is called for on this subject.

In view of the close relationship between growth rate and concentrate consumption, the generally accepted practice of restricting intake to 6 lb a day is open to doubt, when rearing calves for beef. A good start is all-important, and raising the level of restriction to 8 lb or even more would give a higher growth rate at a time when the animal was capable of converting food to weight gain very efficiently. This weight advantage should be carried right through life and could mean earlier slaughtering. The width and depth of the animal might also be improved.

Where calves are not reared in individual pens, they must be grouped together in lots of equal size and stage of rearing. If care is not taken over this point then the larger calves will tend to monopolize the concentrates. At the same time if the feeding is on an individual basis or in groups of calves of equal size, then up to the point of restriction each calf should be allowed to satisfy its appetite. Thus it is desirable to have a constant supply of feed in front of the calves.

In conclusion, it may be said that the general health and appearance of calves reared on an early weaning system need not be very different from the normally accepted standards for suckled beef calves. Growth rate after weaning should be over $1\frac{1}{2}$ lb a day, and only if this is retarded will the development of the conformation be poorer than that of the suckled calf. Perhaps sleekness of coat and amount of fleshing will not be developed to the same degree, but there is no reason why it should be far short of that commonly associated with calves sucking their dams.

Improvement of Sheep

Dennis Hurst, M.S., B.Sc. (Agric.) Hons.
Vice-Principal, East Riding Institute of Agriculture

Most livestock breeders would agree that sound breeding practices and selection systems have considerably raised the economic productive level of our dairy cattle and pigs in the last twenty years. Only in the last few years, however, have farmers and other organizations become interested in "scientifically" improving the national sheep flock.

In the U.S.A. two new breeds of sheep—the Targhee and the Columbia—have been evolved from Rambouillet × Longwool crosses since 1920. These medium finewool breeds have largely been produced as a result of extensive research at the U.S.D.A. Sheep Breeding Station at Dubois, Idaho. They are now the most popular breeds in the extensive range sheep operations of the north-western Rocky Mountain states of Idaho, Oregon, Montana, Colorado, Utah and Nevada. Different selection methods, performance testing and accurate detailed recording have played a major role in developing these two breeds.

Identification of an individual sheep followed by recording are the first essentials to successful selection and adoption of a sound breeding practice. I have tried several methods of identifying sheep, from notching to ear-tagging, and have been most successful with an ear notching system similar to that first used by the Wessex Pig Breeding Society. It is essential that the same responsible person always ear-marks and "reads" the number of the sheep.

Traits to select for

When first contemplating a breeding system in pure-bred flocks, a breeder should consider which traits are of greatest economic value in his flock. Selection should then be practised for as few traits as possible, because progress in any one trait decreases as the number selected for increases. Traits which can be improved most rapidly are those which are most highly inherited. These should be emphasized in any selection system. More experimental results are available for finewool than Down breeds and estimates of heritability assessed for finewools may not wholly apply to Down or Longwool breeds.

Face covering, staple length, fleece fineness and skin folds appear to be the most highly heritable traits. Fleece weight, birth, weaning and body weights are moderately high in heritability, whereas twinning, body conformation and condition or degree of fatness are low. I believe, however, that if we had an accurate method of assessing "meatiness" in a live animal we should find its heritability higher.

American research workers have clearly shown that the relative importance of traits can best be determined by calculating an index on the basis of economic importance, heritability and relationships among traits. Dr. Clair E. Terril, formerly Director of the U.S.D.A. Sheep Breeding Station at Dubois, and now Head of the Sheep and Fur Research Division at Beltsville,

claims that a selection index which combines the records for each trait into one value provides the most efficient way of selecting for several traits at the same time. It is usually necessary to use some sort of an index, if only a mental one, as one must balance the strong points against the weak in ranking animals from poorest to best. A calculated index based on records is most suitable, because it permits a constant and objective degree of emphasis on each trait considered. Without an index, progress from selection is often reduced by altering ideals or emphasis from year to year or by over-emphasizing more obvious traits like conformation and fatness.

An index used in the U.S.A. is given below as an example.

Ewe Index

$2{\cdot}8 \times$ lb weight of fleece + weight of lambs adjusted to 120 days of age. If a ewe raises twins the weights are averaged and 21 points are added; if she has twins and raises only a single, six points are added.

I must stress, however, that a breeder should evolve his own index, and compare results with animals from his own flock only. If a breeder attempts to compare his index "calculation" results with those of another breeder, differences in management and environment will prevent a strict comparison. An allowance may have to be made for year-to-year differences due to changes in environmental condition.

Problem of replacements

One of the biggest problems we have in sheep breeding is the selection of replacements. If these could be satisfactorily selected at weaning, considerable cost, effort and time would be saved. Much thought is now being given at various research centres, and by sheep farmers in America, to performance testing, whereby a breeder can improve his flock through records of performance of his females, and develop a better breeding programme. Records taken at weaning time are being measured against factors of economic importance.

In America the following records are being kept by those practising performance testing.

Identification of offspring and parents and date born

Lambs are ear-marked to determine the correct age at weaning time. It is important to adjust for age so that each lamb can be compared on the same basis. Dams must be identified according to age to compare them to a standard. Ewes between the ages of three and seven are better producers than one to two-year-old ewes and those over eight years. Ewe identification helps to eliminate the "mothering up" process and to keep a permanent record in the flock. The records may also be used in culling old ewes.

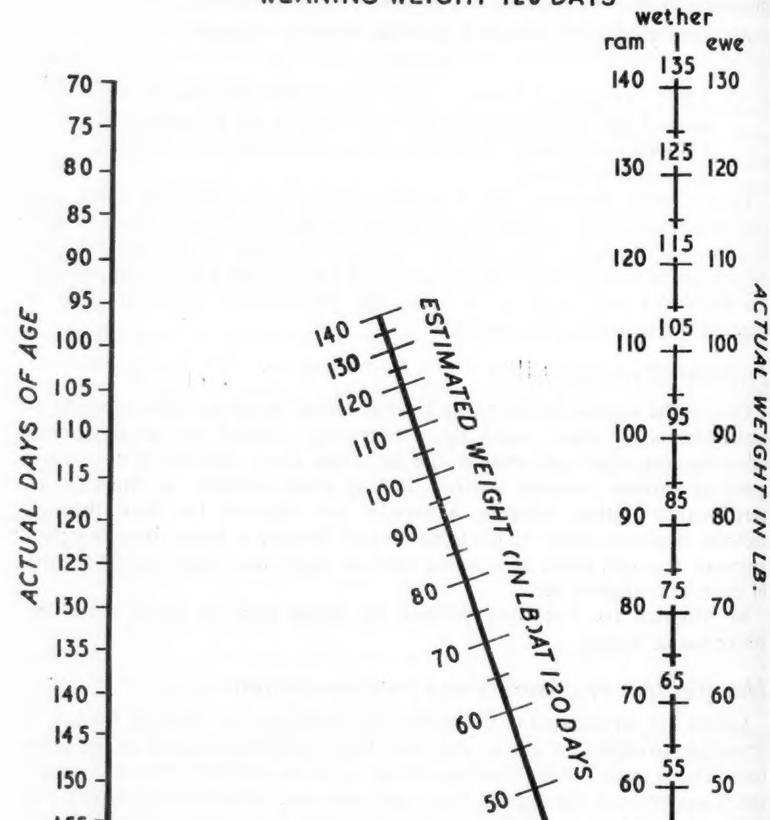
Sex of lambs and types of birth

Lambs are adjusted to a ram equivalent in pure-bred flocks. University of Nebraska research indicates that rams are 10 lb heavier than ewes and 5 lb heavier than wethers at 120 days of age. This is allowed for in the example nomograph on p. 302. Results of research at the University of Idaho, however, indicate that ram lambs are 5 lb heavier than ewe lambs at 120 days

of age, which is about the same as we have shown at the East Riding Institute of Agriculture.

These records are necessary since a single lamb will weigh more than a twin at weaning. If the lamb is born as a twin and raised as a single, then it can be treated as a single. If a twin is raised as a twin for more than one-third of

NEBRASKA UNIVERSITY NOMOGRAPH
AGE AND CORRECTION
WEANING WEIGHT 120 DAYS



TO OPERATE:
Connect age in left column to weight on right column with a ruler and read centre scale for adjusted weight. (corrected to 120days and ram equivalent)

the nursing period, it can be recorded as a twin. Triplets may be treated as twins. At the University of Nebraska, 10 lb is added to a lamb weight for those recorded as twins.

Weaning weights

These are probably the most valuable record which may be kept. They are the best indicators we have so far for rate of growth and "meatiness". The weights can be used in selecting replacement ewes and culling ewes from the flock. Good or poor milkers are easily noted. The lambs should be weighed between 90 and 140 days of age to permit the most accurate adjustment. The adjustments made for weaning weights are: age of lamb, sex of lamb, age of ewe, and type of birth.

At the University of Idaho, the dam's age is standardized on the basis of four to five-year-olds, and the following adjustments are made for other ages:

Age of dam (*years*)	Add per lamb (*lb*)
2	8
3	2
6	2
7	4
8	8

Type "scores"

A score is usually an arithmetic expression from 1 to 15, and is designed to evaluate each animal critically. The highest figure given by a judge indicates the sheep with the most desirable characteristics. When considering the records of performance, a proper balance may be retained, enabling one to select a constitutionally sound sheep true to breed type, which is capable of performing well.

Fleece information

These records are most valuable for wool breeders, and need not be kept by breeders primarily interested in lamb and mutton production. In America some breeders keep the following records: face covering, length of fleece, grade of fleece, uniformity of grade, and pounds of wool sheared at one year of age. These characteristics remain the same throughout the animal's life, except for weight and length, which decrease as the sheep ages.

Yearling records

Only very few research stations in America are keeping yearling records. Yearling records for rate of gain of ram lambs may be kept, as these may benefit producers selling store lambs for feeding. The reason for this is that some rams grow quickly for the first four months and from then their rate of gain is low, whereas some rams which grow more slowly to 120 days reach bigger weights by 9-12 months of age.

Finally, I am sure that by performance testing, breeders selling pure-bred breeding sheep with records of performance based on the most desirable economic characteristics could do much to improve their own, and the national flocks.

Cider and Perry Fruit Production

R. R. WILLIAMS, B.SC., DIP. HORT. SCI.
Long Ashton Research Station, University of Bristol

Recent developments in the cider and perry industry have brought new problems and opportunities to growers of cider and perry fruit.

THE outstanding features of the cider industry since 1945 have been the rapid fall in the production of farm cider and amalgamations of the cider-manufacturing firms. Two major cider and perry manufacturing interests have emerged, one in Herefordshire, the other in Somerset. Both have recently undertaken considerable capital expenditure to increase output and to ensure future supplies of fruit. These manufacturers are anxious to improve the quality of the fruit they purchase, and are prepared to pay special prices for recognized cider varieties. At present not less than 50,000 tons of cider apples and 15,000 tons of perry pears are bought annually from West Country orchards, representing a gross income of £$\frac{3}{4}$ million to the producers.

Orchards planted with recommended varieties and well managed should give an average yield of 5 tons to the acre when in full bearing. Assuming that the demand for cider fruit continues at its present level, there will be a need for at least 15,000 acres of mature orcharding, supplemented by 4,000 acres of young trees as replacements to maintain the future yield. This is about half of the existing acreage, which includes a large proportion of aged and near-derelict orchards that should be grubbed.

Orchards near factories

Although the prospects for new planting may appear promising, results may be disappointing unless care is exercised in choosing suitable sites. Not many years ago there was usually little difficulty in finding a small factory or farm cider-maker within easy reach of the orchard, but this position has now changed with the concentration of the cider-making industry into a few centres. These large factories find it necessary to arrange a strict quota system for the reception of fruit, and the grower is obliged to employ a haulage contractor, who may well have other commitments on the days when his services are needed to transport cider fruit to the factory. It is, therefore, desirable that future plantings should be near the large factories, preferably within a radius of about 25 miles. This limitation will render some existing cider-growing areas unsuitable for future plantings particularly in the West Midlands, where Hereford may well become the only major centre for the processing of fruit.

In Devon the future for cider plantings is not promising. Except at one or two small factories, no extra price is paid for cider varieties, and "pot fruit" such as Bramley, Newton and Belle de Boskoop are taken, but at a lower price than is paid for cider fruit in Somerset or Hereford. Although these low prices are accepted by the present owners of mixed farm orchards, they would not provide an adequate basis for the planting of new orchards of cider varieties.

Gloucestershire still produces the bulk of the perry pear crop. For many years the market was over-supplied, and it is only recently that the demand by a manufacturer of perry in Somerset has led to a trebling of the price. At present most of the pears are transported to Shepton Mallet, which involves high cost and a considerable risk of deterioration of fruit quality. The manufacturers are now raising large numbers of trees to be planted on their own Somerset estates, and no doubt farmers will be encouraged to plant perry pears elsewhere; but this development should be restricted to suitable areas in Somerset and, perhaps, in the southern part of the Severn Vale.

A further important reason for concentrating future plantings of vintage fruit near the large Somerset and Hereford factories is that both manufacturers assist the farmer who undertakes new plantings. This results in considerable financial saving in orchard establishment, which is supplemented by the advice given by the manufacturer on cultural and management problems.

Another factor affecting the location of cider orchards arises from the value of the grass cover as a pasture. To obtain the best return from the grass, orchards should be sited on farms where livestock production is a permanent activity.

Cider orchards also fit well into farms growing hops or black currants, where the labour and spraying equipment already available can be applied to spraying and harvesting the cider fruit. Successful examples of such mixed enterprises are seen in Herefordshire, where a single farm will often produce cider apples, hops, black currants, beef cattle and sheep.

Choices of varieties

When a suitable site has been selected, with the aid of the National Agricultural Advisory Service or the orcharding advisers of the manufacturers, it is essential to plant varieties that suit the district and the factory requirements. Cider apple varieties are divided into four categories—sweet, bittersweet, bittersharp and sharp—depending on the tannin and acid content of the fruit juice. It has been usual to mix fruit of different categories to produce a balanced cider without the need for subsequent blending. At present bittersweets are much sought after and only a few sweets, bittersharps and sharps are being planted. However, varieties possessing extreme juice characters are not esteemed; therefore, the very astringent bittersweets are out of favour, preference being given to the moderate or mild bittersweet, some of which have characteristics approaching the sweet type. Present manufacturing methods make it possible to produce an acceptable cider by using a proportion of "pot apples" and commercial culls, provided that these are balanced with an adequate mixture of bittersweets.

Although the mild bittersweet is likely to constitute the most important element in future orchards, other vintage types should be included if required by the manufacturer. The Somerset cider manufacturers consider that there is a need for further planting of sharp varieties, but the price offered for sharps in other areas is likely to be less than for bittersweets. Triploid varieties, such as Bulmer's Norman, have the advantage that they make vigorous trees under farm conditions. Only a limited number of triploids, however, should be planted because they invariably produce a low-gravity

juice, a character not favoured by the manufacturer. It is important that the varieties selected should include suitable pollinators, and that they should mature their fruit over a period that fits in with factory requirements.

As a guide to potential planters, the Cider Advisory Committee of Long Ashton Research Station issues a list of varieties* recommended for various districts and systems of management. This selection is based on the results of cropping trials in various parts of the West Country and incorporates data on orchard characteristics. Few professional nurserymen now supply trees of cider varieties: the cider manufacturers have their own nurseries, in which they raise trees that are offered to the grower at cost price.

Potato Sprouting Experiments at Terrington

F. E. SHOTTON, M.A., DIP. AGRIC. (CANTAB.)
Director, Terrington Experimental Husbandry Farm

Since 1957 various factors likely to influence the yield obtained from seed potatoes sprouted before planting have been examined in trials at the Terrington Experimental Husbandry Farm. The trials are still in progress but certain results of economic importance have already emerged.

EXPERIMENTS conducted at Terrington E.F.H. since 1957 have been directed to finding what are the best possible conditions under which seed potatoes should be sprouted, and for this purpose an experimental barn-type store modelled on the Continental pattern was erected. This is a building in which it is possible to control the temperature by drawing in cool air from outside and circulating it through the stacks of potato trays; but there are no means of artificial heating or cooling. Another building, more heavily insulated, has a refrigeration unit which enables the temperature to be held a little above freezing point, and within this cool chamber are five cabinets in which a range of differing temperatures can be maintained artificially. The store and the temperature-controlled cabinets are lit by fluorescent tubes which enable the illumination to be controlled. Also on the farm is a glass chitting-house of the type commonly found on potato-growing farms in the silt-land area south of the Wash.

Sprouting is the start of the new season's growth, and its value will depend on the growing conditions to which the plant is subjected during the remainder of the season. At Terrington we have found it to be of great benefit to sprout King Edward potatoes in a season when an early attack of potato blight checks growth. In 1958 sprouted King Edward seed yielded 5 tons per acre more than was obtained from unsprouted seed. On the other hand, in 1959, when there was no blight, sprouting was of no benefit for King Edward

*DUGGAN, J. B. and WILLIAMS, R. R. (1958). Cider apples. A revised List of Recommended Varieties. *Agriculture*, **64**, 11-15.

which had been planted in March. In that year the length of the growing season was not the factor which limited yield, but had planting been delayed by adverse soil conditions in spring, sprouting of the seed might have been an advantage—as it was in fact found to be in other trials in the Eastern Region.

Sprouting has the advantage for the early potato grower of bringing forward the date of lifting, and thus increasing the possibility of obtaining a higher price. This point has not been tested in trials at Terrington but has been confirmed by observations. The fact that sprouting of the seed alters the stage of development of the crop is a mixed blessing for the experimenter, as weather conditions during the season vary and there have been occasions when a later starting crop has met more favourable growing conditions and succeeded in making up lost ground. It is for such reasons that experiments of this type must be conducted over a number of seasons before reliable conclusions can be drawn. Certainly at Terrington, where potato blight limits yield in approximately five years in ten, it is essential to examine the yield data alongside the blight records for the year concerned.

Barn store and glass chitting-house

One of the first experiments to be started after the erection of the new barn-type store compared the effect of sprouting in this store with sprouting in the glass chitting-house. For the maincrop varieties King Edward and Majestic, the differences were very small. With Arran Pilot, there was a marked advantage from sprouting in the barn store rather than in the glasshouse. Seed stored in the glasshouse was trayed on arrival from Scotland in December, and allowed to sprout at will, care being taken to ensure that night temperatures did not fall below 35°F. Seed sprouted in the barn store was also trayed on arrival but, following Dutch practice, it was held below 40°F (at which temperature no visible sprout growth takes place) until February 1st, when the temperature was permitted to rise to 50°F, the lights were switched on for ten hours daily and sprouting was allowed to begin. The possibility that this shortening of the sprouting period, rather than any inherent superiority of the barn store, might be beneficial to Arran Pilot was suggested by the fact that seed kept cool in the store until February 1st and then placed in the glasshouse also outyielded, by 1½ tons per acre at a maturity lift, seed which had been stored from December in the glasshouse.

We therefore began an experiment to look further into this point, and in the early-blight years of 1958 and 1960 it was found that when planting took place at the end of March, Arran Pilot seed which was not allowed to start to sprout until March 1st gave a higher *maturity* yield than seed which started sprouting on February 1st. With Majestic, the results have been quite the reverse, the longer sprouting period giving the highest yield, and it appears that this variety should be started in December. King Edward appears at present to need a longer period than Arran Pilot, though possibly not quite so long as Majestic.

We are now seeking confirmation of the value of a short, four week sprouting period for Arran Pilot lifted as an early. If this can be obtained, the result will be of considerable practical value to early growers, for the tubers which had the shortest sprouting period also had the shortest sprouts—1·4 inches long from 1st March sprouting, compared with 3·1 inches long from 1st February sprouting. The shorter sprouts are far less likely to be damaged

during mechanical planting, and less likely to become unmanageable if planting should have to be delayed. Clearly the actual date for the start of sprouting must be related to the date of planting, and for early districts we would allow the tubers to start sprouting about a month before planting.*

Effect of temperature and artificial lighting

Temperature has been shown to be the factor exerting the greatest effect on length and type of sprout. In the special temperature-controlled cabinets, seed was held at either 45, 55, 65 or 75°F, or fluctuating daily between 55 and 75°F. Arran Pilot has been the most senstive of the three varieties tested, and over the four years 1957-60 the mean length of the apical sprout produced with these temperatures was respectively 1·0, 5·2, 3·6, 1·1 and 1·5 inches. In spite of the etiolated sprouts produced at 55°F, with hand planting these sets gave as high a yield as was obtained from the short, thick sprouts produced at 45°F. With Majestic and King Edward, the temperature effect on sprout length was similar to that on Arran Pilot, though the sprouts were in all cases much shorter. In all varieties the 75°F treatment tended to give the lowest yield. Yield differences due to temperature during storage were not large, however, so that for practical purposes it seems desirable to aim at keeping the temperatures sufficiently low—around 45°—to get a short sprout which still stands handling.

A factor which has produced remarkably little effect on either sprout length or on yield in experiments so far conducted has been the length of artificial light given to the sprouting seed each day. With a fluorescent tube set in front of each tier of trays, a variation of 6, 12, 18 or 24 hours of illumination per day has produced no significant effects in any of the varieties tested. Six hours of bright light daily is clearly sufficient. We have extended this trial this year to test the effect of a reduced intensity of illumination, and of shorter periods of lighting, and we are also looking for any interaction between the temperature at which the tubers are stored and the intensity of illumination.

Variation in response

More work will be needed before we are in a position to report finally on all aspects of the potato sprouting investigations. Our results so far have shown that both the glasshouse and the barn store can produce good results if properly managed, and that management of the seed during storage can lead to increases in yield of 1 ton per acre or more. All varieties do not react to storage conditions in the same way. It is well known that some varieties are liable to "run away" before they can be planted if stored in the same building in which King Edwards are being encouraged to "open their eyes".

We have worked with the principal varieties King Edward, Majestic and Arran Pilot. Observations made on other varieties show that the sprouting characteristics of a variety are not necessarily related to its maturity group. Where a farmer is growing more than one variety our work indicates that it is advisable to treat varieties individually, and this may involve either the division of his sprouting house into two or more compartments or starting different varieties sprouting at different times.

*It should be emphasized that these trials on Arran Pilot were carried out with Scotch seed, and that we have not been able to make comparisons with once-grown seed boxed up in the field at lifting time.

Developments in Seed Testing

P. S. WELLINGTON, PH.D., A.R.C.S.
Official Seed Testing Station, Cambridge

The principles underlying the assessment of seed quality by objective tests were established almost a century ago. Since then, there has been a continuous development of techniques, to meet the problems posed by new methods of seed production and the increasing demand for higher quality seeds.

A REVIEW of developments in seed testing is appropriate in the World Seed Year, designated by FAO, especially as this coincides with the introduction of new seed legislation to supersede regulations which have been in force since 1922. When the scientific principles were first outlined by Professor Nobbe almost a century ago, the interests of farmer and merchant, buyer and seller, importer and exporter, all found expression in different concepts of purity and germination, which were the first attributes of seed quality to be widely recognized. The most fundamental development has therefore been the gradual rationalization of these concepts into a single comprehensive set of rules, sponsored by the International Seed Testing Association, to which more than thirty countries now belong.

The needs

Developments in the United Kingdom have been associated with the seed-producing industry which has arisen since 1945. The need for certified seed of high analytical quality has directed attention to the important effects that new methods of production, handling, conditioning, and storage may have on seed quality. Use of the combine harvester has tended to increase variation within a given lot because seed from different parts of a crop tends to be collected into separate bags. These may have a higher weed content if they are associated with local infestations, or a higher moisture content if there are differences in ripening or lodging. A lower purity may be caused by the presence of broken seeds resulting from wrong settings, or excessive speed, and the need to wait until the crop is completely ripe increases the risk that subsequent germination may be reduced by premature sprouting, or excessive mould development, during wet weather at harvest.

In most seasons it is also necessary to reduce the moisture content by artificial drying, for which the safe temperature is determined by the kind of seed, the initial moisture content, and the rate and duration of drying. Conditions for storage in bulk, or in special paper or plastic containers, are more critical than for storage in the stack or hessian bags. Finally the satisfactory control of seedborne diseases and pests depends on treatment under conditions where phytotoxic damage to the seeds does not occur.

Uses of seed testing

It has to be recognized that the results obtained by seed testing are used for two different purposes. The merchant uses them to compare the value and fix the price of different seed lots; for this the results must be reproducible

within definite limits, which entails standardization of the analytical procedures and control of the external conditions in tests. The farmer, on the other hand, uses them to forecast the field establishment he will obtain by sowing a particular lot of seed; the results of laboratory tests must therefore be capable of interpretation in terms of field performance. Unfortunately these requirements have some incompatible elements, and in order to meet them the work of seed testing stations has had to develop along two complementary lines. One consists of the routine determination of quality factors according to well-established rules, and the other consists of *ad hoc* investigation and research to relate the results of tests in the laboratory with the emergence under field conditions.

In Europe the main emphasis was originally placed on the first line of development and reflected the needs of a vigorous seed trade. In North America, development was mainly along the second line and reflected the needs of pioneer agriculture. Recent developments need to be seen against this background, and are best considered in relation to the following procedures, which form the basis of modern seed testing.

Sampling

The validity of all assessments of seed quality depends on the procedure used for taking samples. Like all living material, seeds are inherently variable, and the normal limits of this variation must be known before the results of different tests can be compared. These limits are determined by the method of sampling which must be designed to provide a representative sample from a variable bulk. Modern methods of harvesting have reduced the chances of mixing by eliminating carting and stacking; this may have to be replaced by artificial mixing, to obtain the necessary uniformity in seed lots. The method of sampling may involve only the use of the hand or it may require a specially designed instrument, but studies have shown that the middle and bottom of the container must be sampled as well as the top. It must therefore be emptied when the hand is used, and a "stick" sampler which is inserted at the top must be divided into separate compartments. A "spear" sampler must also be designed to sample from the middle to the outside of the container as it is withdrawn; tests with the traditional instrument called a "thief" have shown that it is defective because it samples only the outside.

Purity

Purity indicates how much of a lot consists of the seed which is desired. High levels of purity are usually obtained for cereal and vegetable seeds because the differences in size and shape of weed and crop seeds enable them to be readily separated, except for a few which are closely related to the crop seed in which they are found, such as wild oats in cereals and charlock in cultivated brassicas. But the physical characteristics of many weed seeds found in herbage seed are so similar to those of the crop that expensive machinery must be used for cleaning. This represents a compromise between removal of impurities and loss of good seed, and so it is necessary to assess the changes in purity during the process. The production of relatively weed-free crops of herbage seed has been encouraged by relating the charges for cleaning to the purity of the seed harvested.

Weed seeds

Information about the weed content of a bulk is limited by the quantity which can be examined in the purity test; this is so small that only species which are very numerous will be represented. The seeds of different weeds also vary considerably in weight, and therefore their relative frequency cannot be deduced from the percentage by weight. To provide an index of the possible contamination of clean land, counts are made to determine the number of seeds of particularly noxious weeds in a unit weight of the sample. In the past this was applied only to dodder, which has now been virtually eliminated as an impurity in English clover seed; but in future it will be applied also to wild oat, blackgrass, couch grass, and docks and sorrels, which have replaced dodder as the most injurious weeds now distributed by crop seed in the United Kingdom.

Germination

Germination indicates how much of the crop seed is capable of producing mature plants, and is determined under controlled conditions of moisture supply and temperature. These conditions are designed to give the most regular, rapid and complete germination for most samples of the particular crop seed and thus ensure the necessary reproducibility. It would be impracticable to test under field conditions, but in laboratory tests only seeds producing normal seedlings are considered to have germinated; and these must have the essential structures which will develop into the roots, stem, leaves and buds needed by the plant. In recent years greater attention has been paid to the exclusion of seedlings which are abnormal and have no value for field establishment; these are produced by samples with low vigour because of age, mechanical or drying damage, or excessive treatment with seed dressings. The need to provide information on the use of samples for early sowing, when external conditions are not so favourable as in the laboratory test, has been met by tests in sterile and unsterile soil to determine the effects of soil organisms and seed protectants when seedling development is retarded by external conditions.

Origin

Before plant breeders had created the present range of varieties, the country of origin of the seed was often the only indication of its suitability for crop production under particular climatic conditions. Sometimes this could be deduced from the seeds of certain weed species which had a limited geographical distribution, and such determinations were important when herbage seed from regions favourable for seed production, and lacking winter hardiness, was imported into cooler regions. More recently the presence of seeds of diagnostic weeds has been used to detect admixtures of desirable and undesirable types of the same crop seed when the desirable type is scarce. After the difficult harvests in 1954 and 1960, there was a shortage of Italian ryegrass seed of the European types suitable for the United Kingdom, and watch had to be kept for admixtures with seed of Oregon common ryegrass, which was cheaper and very short-lived. These contained weed seeds which are not found in seed of European origin because the distribution of the species is confined to the north-west states of America.

Health

The health of seed, in terms of freedom from seedborne diseases and pests, is increasing in importance with greater intensity of cropping. When the organisms are widely distributed throughout the bulk they may be identified by direct examination of a sample, or culturing seeds on a special medium, or the presence of characteristic symptoms on the seedlings. But when the incidence of the organism is low, although still capable of contaminating clean land as in the case of lucerne eelworm, it is impossible to examine enough seed. The safeguard is then the health of the previous seed crop, or treatment as a precautionary measure.

It is difficult to forecast the effect of a seedborne disease on the subsequent crop because this depends on climatic conditions; but the results of a disease test may indicate when treatment is necessary. Surveys have been made to determine the incidence of bunt in samples of seed wheat, which has decreased progressively from 33 per cent of samples infected in 1921 to less than 1 per cent at the present time; this represents effective control by widespread treatment with organo-mercuric dressings. Loose smut in barley cannot be controlled by seed dressings, but surveys have shown that there are fewer infected samples, and a lower percentage infection, in English varieties, which are more resistant than Scandinavian. Healthy seed of the latter is, however, available from seed crops which have passed the standard required for field approval.

Moisture content

Seed production under the relatively damp conditions of the United Kingdom has increased the need for accurate assessment and control of moisture content. Progressive deterioration during storage occurs above a critical moisture content, and can be prevented only by artificial drying. Sensitivity to temperature is determined by the distribution of moisture in different tissues of the seed. When moisture is uniformly distributed in barley grains the tissues of the embryo are equally sensitive, and grains either germinate normally after drying at safe temperatures or are dead if these have been exceeded. But a moisture gradient is formed when dry conditions follow prolonged exposure to wet weather; the inner tissues are then more sensitive to temperature than the outer and, if they are damaged, typically stunted and abnormal seedlings are found in the germination test because the embryos are unable to use the reserves in the endosperm.

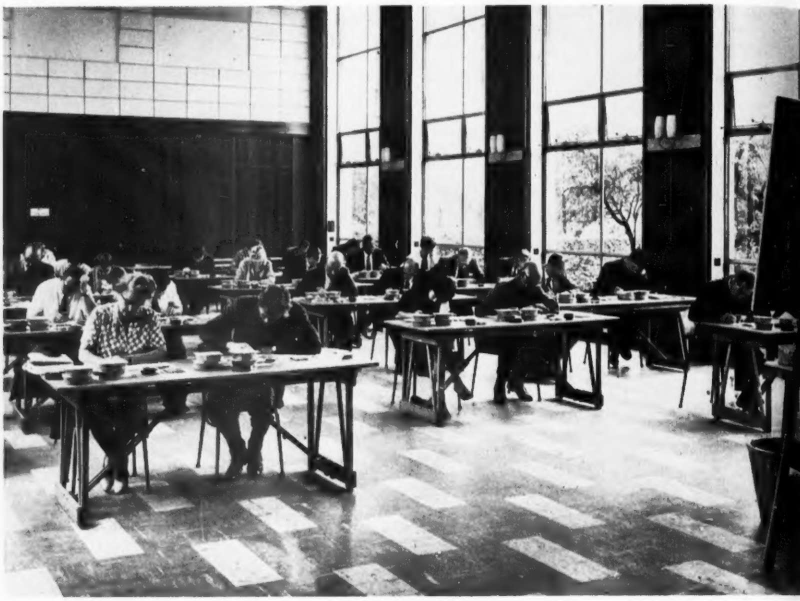
The moisture content of seeds is also a critical factor in determining the time of harvest. During seed development there is a slow and regular reduction in moisture content, as water is displaced by the accumulation of food reserves. But when the water supply between the seed and the parent plant is interrupted, during the final stages of ripening, the moisture content falls rapidly to a level determined by the atmospheric humidity. At this stage the seed can be considered "ripe for harvest" although it may still require a period of after-ripening before becoming "ripe for germination".

Rapid methods for determining moisture content have been developed for use in the field or granary where accuracy is not an overriding consideration. But the accuracy required for storage or shipment can be obtained only by standardized procedures and equipment such as those in the International

Photo: N.I.A.B.

Seed health can be assessed by growing and identifying any disease organisms carried on the seed.

Developments in Seed Testing (Article on pp. 309-13)



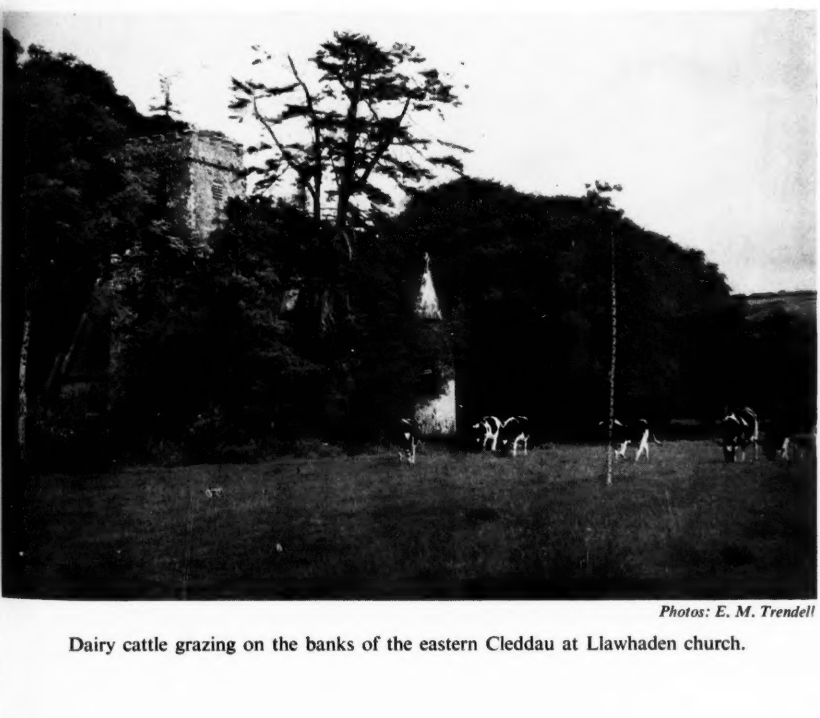
Commercial analysts in training. They must pass the same examinations as official analysts.

Photos: N.I.A

Purity and germination testing.

Narberth District, Pembrokeshire (Article on pp. 325-6)

The valley of the eastern Cleddau river. The Forestry Commission has planted the slope on the left.



Photos: E. M. Trendell

Dairy cattle grazing on the banks of the eastern Cleddau at Llawhaden church.

Photo: Sport and Gen

Environment of Poultry undergoing Selection (Article on pp. 320-4)

Telephoning the number of a trap-nested bird at Wye College to the records office. This avoids the necessity of writing the bird's number on each egg for recording purposes.

Rules. Special precautions must also be taken to ensure that seeds in the sample do not take up or lose moisture to the atmosphere after they have left the bulk.

Training

The Official Seed Testing Station for England and Wales was not opened until 1917, some twenty years after a privately-owned seed testing station had been started in London. The Seeds Act of 1920 therefore provided for statutory tests to be made either at an official station or at a private station operated under licence from the Ministry of Agriculture, and there are now about 120 of these private, licensed stations. The licence is issued in the name of the analyst, who must have attended the same annual qualifying course in the theory and practice of seed testing and passed the same examinations as official analysts. This ensures the necessary uniformity in techniques and interpretations, which are now based on the International Rules for Seed Testing.

The first training course was held at Cambridge in 1921, and in recent years courses have also been held in Edinburgh and Belfast. In 1954 the first international course was held to provide practical instruction for senior analysts in the application of the International Rules for Seed Testing, and another international course was held in 1958 on testing for seedborne diseases. This year, as part of the United Kingdom contribution to World Seed Year activities, a course on seed testing and seed production has been held for representatives from twenty-six different countries. It has been most encouraging to find a wide measure of agreement on the technical basis required for control of quality and certification of seeds, in spite of the very different crops and systems of agriculture with which the participants have been concerned.

Borrowing Money

A. R. Collingwood
Midland Bank

What are the normal sources of agricultural credit? How do banks look on farmer-borrowers, and how does the Treasury control affect each side of the counter?

The very thought of borrowing money was anathema to our Victorian ancestors—though they had no such prejudices against taking extended credit from their tailors, their haberdashers or their grocers. This was a curious attitude for clearly, whether one borrows money to purchase goods or takes the goods and defers payment for them the result is exactly the same, and shame attaches only to the failure to repay the debt on the agreed date. In short, credit—whatever the form it takes—means borrowing money.

Many of us were, no doubt, initiated into the field of credit at an early age when readily-made promises to repay the borrowed half-a-crown were fulfilled only as a result of energetic brotherly compulsion. These youthful misfortunes taught us that promises of this nature are more easily made than kept and that the continued availability of credit depends to a great extent on the creditor's confidence in the ability and the willingness of the borrower to repay his debt; no confidence, no credit. These are salutary lessons of which all users of credit should be aware.

In recent years—coincidental with the development of farming on highly capitalized industrial lines—farmers have become more and more credit-conscious, though one still encounters the odd one who will proudly state that he has never borrowed a penny (this despite the fact that he may owe his merchant hundreds, or even thousands, of pounds). Their opposite numbers in the towns, however, have long been aware that credit is necessary to oil the wheels of modern industry and commerce. So important is this lubricant that when, for one reason or another, the government of the day wishes to slow down the industrial and commercial machine one of its first steps is usually to place restrictions on the supply of credit.

Farmers may feel that they are sheltered from the full impact of credit control and that the subject is one best left to experts. Sheltered they may well have been in the past, but there is no certainty that this happy position will continue.

The largest and most important source of credit for farmers is undoubtedly the banks. There are three simple methods whereby the Government—via the Treasury or the Bank of England—can impose its will on the banks and so affect the supply of credit:

By increasing the bank rate. Interest rates both paid and charged by the banks are linked to the bank rate, an increase in which makes it more expensive to borrow. This acts as a deterrent to prospective borrowers, but in a rapidly expanding economy when profits from investment in the means of production are high the effect is not always so clear cut as one would expect.

By qualitative control. The banks are asked to curtail advances to certain sections of industry or for specified types of finance.

BY QUANTITATIVE CONTROL. A ceiling is placed on total bank advances or pressure is exerted on the banks to ensure that, within limits, their ability to lend is restricted by a real shortage of funds.

After the recent pronouncements of the Chancellor of the Exchequer, all three methods of control are now operating. All borrowers will be adversely affected by the high bank rate (7 per cent), which automatically increases the banks' lending rates; and the personal borrowers, hire purchase companies, and property developers have been brought under qualitative control. The severest feature so far as the banks are concerned, however, is the intensification of the quantitative control. In addition to maintaining 30 per cent of their deposits in liquid form—cash, money at call and Treasury bills—they have now been required to make a further special deposit at the Bank of England of 1 per cent, bringing the total under that heading to 3 per cent, and these funds cannot be counted in the liquidity ratio. As a result the banks will be very short of funds to lend, and their attitude even to customers such as farmers whose efforts are directly and importantly reflected in the country's balance of payments cannot be completely unaffected by the prevailing conditions.

With this background I now propose to examine the types and sources of credit available to farmers and the purposes for which they are used:

Long-term credit

As repayments are spread over a long period it is natural that long-term credit should be available only for financing assets which have a slow rate of depreciation; the purchase or improvement of farms, for example.

The sources of long-term credit are:

THE AGRICULTURAL MORTGAGE CORPORATION LTD. This organization was formed for the specific purpose of financing the purchase of farms. Long-term mortgages can be arranged up to an amount representing two-thirds of a professional valuation of the farm. The Corporation is also empowered to grant loans for improvements to agricultural land and buildings against the security of a terminable rent-charge on the land improved.

THE LANDS IMPROVEMENT COMPANY, which is similarly empowered to grant loans for improvements.

PRIVATE MORTGAGES. These can often be arranged at comparatively low rates of interest but a clause is usually included in the mortgage deed allowing the mortgagor to repay, or the mortgagee to call for repayment, at six months' notice.

INSURANCE COMPANIES. Advances by insurance companies are arranged at varying rates and insurance cover must be taken out—a very wise precaution in the case of a family man.

BANKS are not normally anxious to make mortgage advances—particularly while present conditions prevail—but one of the 'Big Five' has a loan scheme for the purchase of farms. Interest is charged at 1 per cent over bank rate, with a minimum of 5 per cent, and repayments can be spread over a maximum of twenty years.

Medium- and short-term credit

Medium-term credit is used to finance the purchase of farm machinery, equipment, implements and movable buildings and the two main sources

are the banks and the hire purchase companies. Hire purchase finance is far more costly to service than that taken from the banks.

Short-term credit is available to supplement the farmer's own capital, and is used for the day-to-day or seasonal running of the farm. The sources of short-term credit are the merchants, the farmers' co-operative trading societies and the banks. Ideally the farmer should be in a position to take advantage of the discounts offered by the merchants and trading societies for if he misses them the cost of his credit becomes high. The Radcliffe Committee which investigated the cost of farm credit amongst other things, assessed the average rate charged by merchants at 12 per cent a year. Once arrangements for this type of credit have been made with the banks—which usually charge 1 per cent over bank rate—minimum 5 per cent on the net amount borrowed—the farmer can expect the facilities to be renewed annually or even increased until such time as the holding is farmed to maximum capacity, provided always that he continues to farm profitably and to retain a fair measure of those profits in the enterprise.

The mere existence of these sources of credit does not imply that they are available to any farmer without limit; he must first establish his creditworthiness. In the case of hire purchase finance the ability to provide the deposit goes a long way towards this, particularly as the hire purchase companies almost invariably retain the ownership of the items purchased until all the instalments have been met. The position is similar when only a proportion of the total cost of a farm is advanced on mortgage, for the mortgagee is secured by deeds which, at the time of the advance, have a value considerably higher than the amount of the mortgage. In the case of merchants and trading societies, which receive no tangible security, and in the case of banks, where the advances are often partly or even wholly unsecured, enquiries as to the creditworthiness of the borrower are likely to be rather more searching. In my own bank we consider that we are dealing with a farmer who is worthy of our assistance and will put our money to proper and successful use if:

a. He is a man of integrity who knows his farming and is willing, if necessary, to seek and take expert technical advice.

b. His holding can be farmed to produce profits sufficient to provide him with an adequate living and, at the same time, service the credit he wishes to take.

c. His own capital in the enterprise is in reasonable relation to the amount he wishes to borrow.

It is no accident that the last condition is capable of wide interpretation, for the circumstances surrounding proposals put to us can vary enormously. Nevertheless, the basic principle is extremely important; other things being equal, the less the farmer's capital resources in proportion to the amount of credit taken, the greater the danger both to the creditors and to the farmer himself. Overtrading—that is, trying to do too much with too little capital—is a disease which claims many victims, as recent experience in the broiler industry has shown.

Having decided that credit will be available to finance the project he has in mind, a farmer should satisfy himself on the following points before entering into the new commitment:

a. That if a deposit has to be found its provision will not so reduce his

resources as to leave him without any reserves to cope with the periodical set-backs inevitable in farming.

b. That the proposed expenditure will increase the profitability of the farm enough to cover the cost of the credit, the repayments, and still leave an appropriate margin.

c. That having regard to the long-term plan for the development of the farm—and there should always be a long-term plan—the current project heads the priorities.

d. That the least expensive and most convenient method of financing the expenditure has been found.

If he is so satisfied then all should be well to go ahead, but if he has any doubts at all, he should consult the N.A.A.S. or some good farm consultants. A second opinion, even if it only confirms one's own views, is always worth while.

Finally, what of the good farmer whose position—at any rate on paper—does not appear to justify the further credit which he needs and which he could put to profitable use in the development of his farm? As a banker I can assure him that we are much more likely to provide additional facilities if he has consulted his N.A.A.S. officer and can, in consequence, produce a report indicating not only that he is a good farmer but that with a little more capital he could be even better. Alternatively, he can contact that excellent organisation,the Agricultural Credit Corporation Limited, which will produce a similar report and, if satisfied, will supply a guarantee at small cost to cover the bank borrowing. I trust that this article will have left the thought with the reader that, whilst there is no virtue in not borrowing money, there are grave dangers in borrowing too much, and that to borrow money and spend it unwisely is the greatest folly of all.

Concrete Loading Bases

R. B. SAYCE, F.R.I.C.S., Q.A.L.A.S.
Agricultural Land Service, Eastern Region

Concrete bases for sugar beet and other crops are becoming an essential feature of the arable farm. Though they appear to be simple things, a little thought will ensure that they can be used to maximum efficiency.

BECAUSE of the exceptionally wet conditions during the sugar beet harvest of 1960, many farmers had great difficulty not only in getting their harvested beet off the fields but also in loading on to lorries or railway trucks. The increased use of machines for handling harvested beet and other crops has given rise to a need for a hard dry place on which to store the crop during loading. One solution is a concrete base: farmers who have put in such bases have speeded up their operations and reduced their labour requirements. However, before such a base is constructed some careful thought is needed if it is going to give the best result.

Siting

The most important factor is the siting of the base. The two primary questions in siting are how far are the fields from the base, and can the transport get right up to it. The distance to be travelled from the fields will determine whether one single base will do or several smaller bases are needed. Whilst no firm advice can be given about the limit of distance which should be travelled by tractors and trailers from the fields, half a mile is probably the most economic operating distance.

The size of the farm and its general layout will also influence this choice of a single base or multiple bases. Often with a small, compact farm of up to, say, 150 acres, one central base is sufficient. For larger farms, bases for groups of fields are usually the answer. This again depends on the farming policy and the crops which will be using the bases. It is usual in East Anglia to find groups of arable fields on which each year there will be at least one or other of the crops such as sugar beet. However, the final choice of a single base or multiple bases may well be decided by the geography of the farm itself and the roads, railways or rivers which serve it. Double handling must be avoided, and this may mean that a longer run by the tractors and trailers to the base has to be accepted.

It is important that where a concrete base is to be on the boundary of the farm, there should be no doubt about ownership of the site. For example, in the Eastern Counties the exact boundary between a farm and the public highway is often not clearly defined. It is important that the County Surveyor should be consulted before any base is constructed, in order that the boundary can be agreed and marked. It may also be necessary for planning permission to be obtained, and therefore the local planning authority should be consulted. If the base is to adjoin a railway, the District Surveyor for British Railways should be approached. Beet is often transported by river barge, and if the base is to be built next to a waterway the river board for the area should

be consulted. Some waterways may not be under the river board's jurisdiction, but the consent of the internal drainage board may be needed.

Design

A concrete base is no more than a slab of concrete which can be likened to a section of road. In assessing its overall size and shape, the following factors will have to be borne in mind. It is easiest to relate these to sugar beet as this is probably the most important crop which will be stored on the base:

1. The quantity of beet to be stored;
2. The need for working space for mechanical loaders; and
3. The methods of loading.

The quantity of beet to be stored will depend on average yields, rate of harvesting and rate of loading. As a guide, the space requirement of sugar beet is about 65 cu. feet per ton, and the table below shows the storage capacity of bases of differing sizes, assuming beet stacked with sides at 45 degrees or more.

Stack height (*feet*)	Width (*feet*)	Tons per ft run
6	20	1½
	30	2¼
	40	3
8	20	1¾
	30	3
	40	4¼
10	20	2
	30	3½
	40	5

The second factor is the need for working space. Here one must remember that the base is going to be used not only for storing harvested beet, but also for the machines to operate on. If the whole of the base is filled with sugar beet, then foreloaders and cleaners will have to start operating off it; and this, by leading to a muddy morass around the edge, can defeat the whole object of a base.

Many different methods of loading sugar beet are used, but the commonest is by foreloader. Where a foreloader or, possibly, a cleaner-loader is used, a plain level base will suffice. It is an advantage to have a dwarf wall against which the foreloader can operate to pick up the last beet in the heap. Sometimes, however, a bulldozer is used, and then a ramp or loading bay may be required. At times it is possible to take advantage of differences in site levels to make the concrete base at lorry height.

All the above factors of design relate to sugar beet loading, but quite often other uses must be borne in mind. A concrete base can well be used for potato riddling and bagging, for storing manure from yards, and for stacking baled hay and straw. It is also very useful for carrot grading and washing, where a source of clean water is near.

Construction

The construction of a concrete base and a concrete road are identical. All surface vegetation should be removed from the site before the concrete is

laid. On stable soils (sands and gravels) a hardcore sub-base can be omitted, but on less stable soils a layer of compacted hardcore 3-6 inches thick will be required. The concrete slab itself is usually between 4 and 6 inches thick, depending on the type of soil, but unless conditions are very favourable 6 inches is to be preferred. On peat, silt or similar soils, metal reinforcement should be incorporated, and this is usually laid about 2 inches from the top of the concrete.*

Where a hardcore surround is desired, it can be provided with well compacted gravel or broken brick, with a binding agent such as silt or sand rolled into the surface. If walls are to be provided, either as the dwarf walls mentioned above, or as retaining walls for a loading bay, then their construction should be commensurate with the load they must bear. Generally they will require reinforcement. For example, a 9-inch concrete block or brick wall, not exceeding 6 feet in height, should be reinforced horizontally in every course. If the wall is not backed by soil, piers of 18 × 9 inches should be added, not more than 5 ft 3 in. apart, and bonded into the wall.

Environment of Poultry Undergoing Selection

P. HUNTON, B.Sc. (DUNELM), M.Sc. (LONDON)
Wye College, University of London

Mr. Hunton reviews the suitability of battery and deep litter systems for use in selection programmes to improve stock quality, drawing on a 10-year experiment at Wye College.

WHAT kind of environment should breeding stock be given?

Firstly it must permit the fullest possible expression of the genetic potential for the characteristics being selected (in the present instance hen housed egg production). If the end product is to be commercial laying stock, it is essential also that the parent stock's environment should be comparable with that to which their progeny will be subjected. This is especially true of a characteristic, such as egg production, which is influenced much more by environment than by heredity. Although the subject of genotype-environment interactions is a complex one, there are signs that stock capable of performing well in one environment may not perform equally well in another; furthermore the differences between birds and between strains may alter in size and direction according to environment. Therefore the environment of a breeding flock must approximate to that prevailing in the commercial field.

*For full details of the construction see Fixed Equipment of the Farm Leaflet No. 33, *The Concrete Road*.

Secondly, the environment must be uniform. It is essential that all birds should, as far as possible, experience a similar environment while under test. Any environmental influences which affect some birds but not others will tend to increase environmental variation, and make identification of superior genotypes correspondingly more difficult. Since environment accounts for 80 or 90 per cent of the observed variation in hen housed egg production under most conditions, any stabilization which could be achieved by greater uniformity of environment would be valuable.

The third requirement of environment in this context is that it should permit adequate and accurate recording. Breeders usually need egg numbers and egg weights; therefore it must be possible to identify quickly and easily the eggs laid by particular birds throughout the test period. Body weights and feed consumption are also frequently required. As skilled labour is often not available, the type of housing used should allow recording techniques to be simple and quick. There will inevitably be an element of human error in any system of recording, but the system must be so designed that it is minimized. It must be possible to identify individual birds quickly and accurately; if it is not, such measures as body weights will be extremely difficult to obtain in a reasonable time, and selection of birds for breeding purposes may become time-consuming and/or inaccurate.

Battery cages and deep litter

How far do battery cages and deep litter houses fulfil the foregoing requirements?

It seems from experience at Wye and other research centres that both systems, given good stock, will permit a reasonably high level of egg production. This has certainly been the experience in commercial practice, where some 70-80 per cent of the nation's laying stock is housed under one or other of these systems.

Various economic surveys have shown that hen housed production tends to be higher in battery cages than on litter. This is borne out to some extent by the Wye data presented later, in Table 1. The difference in favour of cages seems to be of the order of 15 to 20 eggs per bird housed per year. Whether this is due to increased egg number in cages or to higher mortality on deep litter is uncertain.

There can be no objection on grounds of productivity to housing breeding stock (or potential breeding stock) on either of these two systems. Both permit expression of egg production to a high degree, and both are representative of conditions in the field.

The question of uniformity of environment is more difficult. In cages each bird is confined to one small fraction of the total environment and has no opportunity of experiencing any other conditions than those of its own cage. Each cage will have its own peculiarities of light and temperature. Furthermore conditions will vary considerably from the bottom row of cages to the top, and from one side of the battery to the other if it is double-sided. So far as comparisons between family groups are concerned, these difficulties may be overcome to some extent by proper randomization of birds, but the problem of variation between cages remains and may tend to increase the environmental component of variation and reduce heritability estimates.

In deep litter, on the other hand, the bird is not confined to one particular part of the house but may move about at will, thereby experiencing a range of conditions to which all the birds have an equal chance of exposure. Whether or not this is an advantage is open to question. Individual birds may prefer, and limit their activities to, particular parts of the house which themselves constitute different environments. Furthermore, when considering any particular bird, all the other birds can be said to form part of its environment; a social order (peck order) is established and may influence performance to some extent. Bullying and cannibalism can be features of flocks kept on deep litter, and these may obscure differences in the birds' genotype for egg production. One could well argue, however, that these conditions will also prevail in some commercial units and that birds bred under such conditions may well be more capable of withstanding them.

The battery system lends itself to accurate recording where birds are kept one per cage, as was the practice at Wye. In deep litter houses, one must use trap-nests for recording egg production. Birds must be trained to use these nests, and a certain amount of misidentification on the part of the operators can be expected. Experience at Wye suggests that the proportion of eggs laid on the floor throughout the year, after the initial "training" period, is about 3 per cent. This, although not alarming, is considerably less accurate than records obtained from caged birds. Trap-nests are expensive to install and maintain, and there must be enough to meet the highest level of production anticipated. At Wye they are installed at the rate of 35 per 100 hens, and are emptied five times a day. Another feature of trap-nesting is the necessity of writing the bird's number on each egg so that it may be identified for recording purposes. There are ways of avoiding this, such as installing a telephone system from the trap-nests to the records office, or by using a movable record chart which is taken round by the trap-nest operators. None of these compares for simplicity with the battery cage record card. Body-weight measurements are obtained more easily and without much disturbance to the flock from caged birds.

The battery system has, however, one major drawback when used for breeding and selection work. It is impossible to use caged birds to produce hatching eggs unless one is prepared to use artificial insemination on a large scale. In the early stages of the selection experiment at Wye the test flock, on which the production measurements were carried out, was not used for breeding (being entirely in cages) but full sisters of the selected families were mated in outside pens. This involved considerable duplication of families, as seven full sister pullets were required for the test flock in cages and a further eight full sisters were kept elsewhere until selection time. On deep litter this problem does not arise: at selection time (in our case part of the way through the pullet year) selected families may be withdrawn from the main flock and housed in pedigree breeding pens without much disturbance.

Artificial insemination can be used successfully on caged birds but takes time and requires skilled staff. The alternative of moving birds from cages to the floor for breeding has two serious disadvantages: a fall in production may occur, and birds may not use trap-nests if they are not familiar with them.

Wye College breeding programme: description and results

In 1948 a long-term selection experiment was set down, using a repre-

sentative sample of Rhode Island Reds drawn from various sources. A description of the first few years' work is given by Cooper and Maddison (1954).* The results reported here were obtained between 1951 and 1959.

During this period the criterion of selection was the hen housed production of full sister families during their first 19 weeks of lay. From 1951 to 1955, 7 birds from each full sister group were housed and recorded in battery cages and a further 8 full sisters were housed in semi-intensive pens. The battery cage birds constituted the test flock, and the birds used for breeding were the full sisters of the best sister groups in the test flock. Males used were full brothers to the superior test flock sister groups. This system involved producing full sib families of 15 females from each pullet in the pedigree breeding pens.

In 1955 the whole flock was housed in a deep litter house. The same criterion of selection was used, but the family size was reduced from 15 to 10 females, all being tested in the deep litter environment. Birds selected at 19 weeks were withdrawn from the main flock and housed in pedigree breeding pens in another part of the deep litter house.

At no time during the experiment have the two systems been in operation simultaneously; therefore a direct comparison of performance is not available. Table 1 shows the hen housed production of the test flock for the whole period 1951-60, to selection time when the average age is 275 days, and to the end of the test period when the average age is 500 days.

Table 1

	Hen Housed Production No. of eggs		Environment of Test Flock
	275 days	*500 days*	
1951-52	55	168	Battery cages
1952-53	58	190	,, ,,
1953-54	61	188	,, ,,
1954-55	69	199	,, ,,
1956-57	66	180	Deep litter
1957-58	72	183	,, ,,
1958-59	86	196	,, ,,
1959-60	89	191	,, ,,

No figures are given for 1955-56, as at this stage the transition from batteries to deep litter took place and no data is available.

In 1954-55, 500-day production had reached 199 in cages. After the change to deep litter and in spite of a further generation of selection, this figure had fallen to 180. The difference of 19 eggs compares favourably with the differences observed by surveys in the field.

Further progress achieved since then has raised performance on deep litter almost to the level obtained in cages, and it is suggested that if the present generations were housed in cages their production should be of the order of 210-220 eggs in 500 days.

The 275-day production figure fell by only 3 eggs on changing the environment. Since selection is based upon this record, one might expect a faster recovery from the lowered productivity brought about by the change.

Heritability estimates are calculated from each year's data. Heritability is

*Cooper, M. McG. and Maddison, A. E. (1954). A preliminary report on a poultry breeding project. *Animal Breeding Abstracts*, **22**, 183-90.

defined as the fraction of observed variation which is genetic in origin. The remainder of the variation is assumed to be environmental; one might therefore suggest that heritability estimates, besides being valuable to the geneticist, also give some indications as to the uniformity of the environment. Estimates obtained are given in Table 2.

Table 2

	Heritability		Environment
	275 *day record per cent*	500 *day record per cent*	
1951-52	38	10	Battery cages
1952-53	23	23	,, ,,
1953-54	14	23	,, ,,
1954-55	22	02	,, ,,
1956-57	28	24	Deep litter
1957-58	24	11	,, ,,
1958-59	23	21	,, ,,
1959-60	29	27	,, ,,

The mean heritability values obtained from records of caged birds were 25 and 15 per cent forpart record and full record. Corresponding mean values from deep litter birds are 26 and 21 per cent. Although these estimates may be subject to considerable errors, values seem to be higher for the deep litter environment. Support is given to this view by the fact that heritability values might be expected to decline over the 10–year period as a consequence of the selection programme, which tends to reduce genetic variation. If these findings are correct, they suggest that the deep litter environment is more uniform and therefore gives genetic variation more chance of expression and recognition.

So far as running the experiment is concerned the deep litter system has been quite satisfactory, in spite of the acknowledged fall in productivity. The size of family required is smaller (10 as opposed to 15) and these families can be obtained in a shorter hatching season, thus reducing the age range of the pullets under test. Inaccuracies undoubtedly occur in the recording process but it is considered that they are not of sufficient magnitude to affect results materially.

Farming Cameo: Series 2

41. Narberth District, Pembrokeshire

E. M. TRENDELL, N.D.A.
District Advisory Officer

THE Narberth district is bordered on the east by Carmarthenshire and on the north by the Prescelly Mountains, from which the boundary runs down to the tidal estuary of the River Cleddau. The ancient market town of Narberth, in the centre of the district, is the only habitation of any size. Fairs and markets have been held here for generations, but in modern times the farmers are tending to travel further afield, to Haverfordwest and Carmarthen.

The district is crossed by the historical Landsker, which follows the line of castles from Narberth to Llawhaden, Wiston and Roch. Most of the inhabitants to the north of this line are of Celtic origin and bilingual, whilst to the south they are mainly of Flemish origin, speaking only English. The south of the district is, in fact, in what is commonly known as "Little England beyond Wales".

The climate of the area is rather humid and warm, with few frosts and few falls of snow, the prevailing wind being south-westerly. The average rainfall is 45-50 inches a year.

There is a remarkable variety of soil types in the district, and very often great differences can be found within short distances. The most productive soils in the south are those overlying Old Red Sandstone. These form a strong red loam, and are capable of growing a variety of crops. Adjacent to the Old Red Sandstone will be found soils overlying carboniferous Limestone, Millstone Grit and Coal Measures. The Limestone soils are easily cultivated, but those on Millstone Grit are often poor and stony; the Coal Measures are generally rather damp and mainly laid down to grass. In the north of the district there are soils derived from Silurian and Ordovician shales together with pockets of boulder clay, sand and gravel. The soils on the edge of the Prescelly Range, light in texture with boulders present in many cases, are rather poor and require frequent manuring. The whole area is undulating, and many of the steeper slopes are being planted by the Forestry Commission.

Agriculturally, this is a district of great variety; hill sheep will be found grazing the Prescelly Mountains, and in the south early potatoes are successfully grown. Pride of place however, must go to the dairy cow, for this is mainly an area of small family farms with milk selling as the chief enterprise. The tradition of milk production goes back to the 1914-18 war, before which the general farming system was butter and cheese making and the raising of store cattle and sheep. The latter are still important enterprises on the larger farms, the Hereford cross being most popular for beef and the Suffolk ewe for early fat lamb production.

As in many other areas, the most predominant breed for milk production is the British Friesian. The quality of the cattle is generally very good, and most farmers rear their own replacements. Fairly heavy stocking is the rule;

taking the district as a whole, there is one livestock unit for every 2½ acres cultivatable land.

Cropping is mainly related to the requirements of the dairy cows, and only 14 per cent of the total acreage is under arable crops. Barley, with its higher potential yield, is fast taking the place of oats and mixed corn as the most popular cereal. Green crops in the form of kale and rape are widely grown, but root crops for animal consumption have gone out of favour in recent years.

Early potatoes are an important crop in the south, and are mainly grown on the Old Red Sandstone and limestone soils. This is not quite such an early district as the coastal areas, but it is usual for crops to be planted in early March and lifted by mid-June. The main varieties grown are Arran Pilot, Home Guard and Ulster Premier. Dry Mays are often experienced, and irrigation is now being practised on some farms with worthwhile results.

The most important crop in the district is undoubtedly grass. With a mild climate and lack of frosts, growth takes place both early and late, and one of the problems on the heavier soils is to make full use of the grass without poaching the land. In the area immediately round Narberth there is much useful permanent pasture, but on the lighter soils leys are usually ploughed up after 5-6 years, and put through a 3–year arable rotation. The most popular leys are composed of perennial ryegrass, timothy and white clover. Italian ryegrass too is becoming popular, especially on the smaller farms.

About one-third of the total area of clean land is mown for hay and silage each year. The use of the pick-up baler is now universal for haymaking, and the quality of the crop is being improved by better manuring, earlier cutting and the use of modern tedding techniques. Silage-making has progressed rapidly in recent years, especially since the introduction of the forage harvester and the Silo Subsidy Scheme. About one-fifth of all the farms over 15 acres now have silos erected under this Scheme. Various forms of self-feeding of silage are being practised, and these are being combined with yard-and-parlour systems on some farms. This is a big change from the traditional cowshed system, the greatest drawback, however, being the shortage of straw. Modernization of fixed equipment has, in fact, gone forward by leaps and bounds under the Farm Improvement Scheme.

Over half the holdings in the district are in the 20-100 acres category, so it is not surprising to find that the Small Farmer Scheme has proved very popular. More efficient milk production is the aim of the majority of the schemes, and it is being achieved by increasing the size of the enterprises and making better use of home-grown and purchased feed.

This is not an industrial area, and for recreation the people still turn to the traditional entertainments of country life. These include singing at the local eisteddfodau, fishing in the rivers Cleddau, Syfynwy and Taf, and for those interested in horses, hunting with the Pembrokeshire and South Pembrokeshire foxhounds.

Your Fixed Equipment

Saving Labour at the Food Store

L. M. PARSONS

Agricultural Land Service, East Midland Region

ON many farms, food preparation and feeding take up much more labour than they need. It is unusual to find really efficient food storage and feed-handling routines. The storage and handling of concentrated feedingstuffs can always be simplified, and costs cut, by better arrangement of the buildings used and a better routine for feeding. If your concentrates are home grown, it seems commonsense to store the ingredients as close as possible to the points where they are to be prepared or consumed. Handling food can be made considerably lighter by so organizing the interiors of the buildings used that transport and circulation are reduced to a minimum. The time and energy used in handling concentrates does not depend entirely on the weight carried, but very much more on how the job is done.

In the foodstore, a lot of manual labour is required. And yet jobs requiring care and accuracy are often carried out in dark, dusty surroundings, on rough floors, through awkward doorways, or without any mechanical aids to lifting or moving. Frequently, too, only buckets or skips are used to feed the stock. Even on the apparently well-equipped farm, it is always possible to save an immense amount of time and trouble by looking critically at routines and methods. Badly designed buildings and layouts mean bad methods, and these, together with the needless fatigue and poor working conditions so often associated with them, mean that the stockman has insufficient time or energy to do the job he is paid for—and this includes rationing of feedingstuffs.

In the coming years, bulk handling and storage will play a considerable part in reducing costs of production. But these techniques demand skilful farm management and bring problems of their own, including those of accurate mixing and feeding, the avoidance of waste or overfeeding—and much more to the point, the costs of storing in bulk.

With purchased concentrates come the problems of forward buying,what kind to buy,and the costs of particular methods of delivery and subsequent handling. Again, feeding from bulk means that small quantities still have to be given to each kind of stock. Unless this is an easy, foolproof process, considerable financial losses can creep in. In general, too, mixtures prepared frequently and in small lots are fresher and more palatable to stock, so that it is essential to allow ample space for storing various ingredients.

The decision to install bulk storage facilities will also be influenced by the classes of stock. The types of rations fed to each should be as simple and few as possible, because it is no use having bulk storage unless considerable labour can be saved in the routines of mixing and feeding. Equally, unless bulk delivery of purchased ingredients is possible there is no point in constructing elaborate bin systems. But, if these bins can be situated at the point of feeding, considerable savings in packaging, unpackaging and transport, loading and unloading can be achieved.

It is always worth while trying to store and prepare the food as close as possible to the stock which are going to eat it. For example, purchased food can be delivered to a food store or to bulk feeders in the actual house. The bulk store over the parlour and the automatic bulk feeder for pigs have amply demonstrated their effectiveness in saving labour. Loading and unloading take time and trouble, and when food is moved they cause costs to rise because travel time is usually short. This is why unloading should occur only once, at the point of consumption.

But the possibilities of wastage in bins are much greater than with the sack. These losses can be caused by overheating, condensation or caking, and wastage by the animals themselves. There are also the practical problems of disinfesting the bins from time to time and the financial problem of depreciation and maintenance.

No bulk store system should be installed without taking the best advice available, not only on its effect on the farming system but also on details of its construction.

When it comes to feeding from bulk there is no doubt that the use of a properly designed trolley, combined with smooth pathways, can show really substantial savings in energy and time. Even if bulk storage in bins is not possible, it is always worth considering reorganization to provide a new food room. But a good feeding trolley and proper equipment are just as important.

Circular routes and feeding direct to mangers with suitable equipment can always avoid some of the unnecessary packing and unpacking which add so much to costs. At the same time, whichever method is decided upon, the possibilities of grouping similar stock together should not be forgotten. Moving from one house to another wastes much time. And the actual times of feeding can greatly influence the whole job. It has frequently been observed, for instance, that feeding during milking in a cowshed can take twice as long as doing the same job before the cows come in. Management decisions are therefore as important as detailed routines.

Bought concentrates in bulk are not usually bulky powders or meals, and are therefore much more easily handled without waste. Meals, on the other hand, are more difficult to handle, and their movement should be kept to a minimum. But countless routines have been seen where sacks are filled from a mixer only to be tipped into a bin later on. Each operation means some losses: once meal is in bulk it should stay in bulk until it is fed.

Worthwhile savings can be made only by examining carefully every detail of the routine from collection of the ingredients to their final consumption. A small but wise expenditure on new equipment or building alterations can always be recouped as savings of wasted food.

Where should we put the bulk store at the farmstead? Separate stores for each livestock unit can show enormous savings in food distribution. Nevertheless, if unloading at these points of final use is difficult or expensive to install, a large central store with easy access for lorries or trailers is almost as suitable. But a satisfactory performance with this arrangement requires first-class equipment. Travel distances of up to 100 ft from store to animal may have little real effect on the time taken to carry out a carefully contrived routine, if the arrangement of doors and interiors is as labour-saving as possible. In the last analysis the cost of moving materials could mean profit or loss on the entire enterprise.

Handbuch der Pflanzenphysiologie

(Encyclopaedia of Plant Physiology)

Vol. 5: The Assimilation of Carbon Dioxide. Parts 1 and 2*

Vol. 12: Plant Respiration, including Fermentation and Acid Metabolism. Parts 1 and 2*

OUR German scientific colleagues have for long been recognized as outstandingly good compilers of encyclopaedias. All who are concerned with the cultivation of plants will find that once again we owe them a debt of gratitude for having started to compile an all-embracing treatise on the rapidly expanding subject of plant physiology. It is sad to learn that Professor Wilhelm Ruhland, the editor, died before seeing his task completed, and a tribute to this great man is paid by H. Ullrich in one of the volumes under review.

It is a sign of the times that, whereas the great German botanical treatises were, until quite recently, written exclusively by German-speaking botanists in their own tongue, it has now become customary to produce works of this kind on an international basis with contributions from leading specialist authorities, written in English or French as well as in German. This practice means that the best informed opinions are brought together within the compass of a single work, whilst accuracy of presentation is assured by the collaboration of assistant editors of various nationalities.

It is, of course, impossible for a reviewer to comment in detail on the contents of an encyclpaedia of such monumental proportions as we are now considering. Indeed the subject is so vast that it would probably be impossible to find a single botanist who could do so. Some idea of the scope of the work may, however, be given by stating that the whole is to consist of eighteen large volumes, some of which are each to comprise two parts. Two volumes are to be on General Foundations, eleven on Metabolism and five on Growth, Development and Movements.

The volumes now under review, each in two parts, deal respectively with the assimilation of carbon dioxide and plant respiration. Every conceivable aspect of both subjects is covered, in well-written articles. Here one can read about such topics as the respiration of germinating seeds, the effects of growth-regulating substances on respiration, the respiration of mosses and the metabolism of organic acids, to take but a few examples from the volume on respiration. If our interest should lie in carbon assimilation, we can read about the uptake of carbon dioxide by plants in tropical rain forests and by those submerged in water, or by those which inhabit deserts or grow on mountains, apart from the more usual aspects of this subject. Even the uptake of carbon by iron bacteria, sulphur bacteria and selenium bacteria are covered.

It only points the obvious to say that this book should be available for reference in as many agricultural and botanical laboratories as can afford its necessarily high price. But the reviewer can almost hear the farmer asking himself what all this has to do with him. For the answer we may turn to

*Price (Vol. 5) D.M. 530; (Vol. 12) D.M. 598. Springer-Verlag, Berlin.

Professor W. E. Loomis who, in a most fascinating discussion on the history of photosynthesis, says that although agriculture is 10,000 years old, photosynthesis was not seriously considered until the end of the eighteenth century. He then continues significantly: "In view of estimates that the human population of the earth will triple in less than a hundred years, the study of photosynthesis is more than a matter of academic interest". How true this is; and it may serve to remind us all that although space travel and atomic energy command so much of our attention and financial resources, the ultimate fate of the human race on earth will depend largely on the ability of biologists and food producers to collaborate in preventing world starvation. It may at first sight seem a far cry from the study of photosynthesis to the elimination of starvation in, say, India or the Far East. Nevertheless the connection exists, perhaps more closely than some of us yet realize.

In these days when new discoveries in plant physiology are being made with such bewildering rapidity, it is only by means of encyclopaedias that the specialists engaged in this work can keep before them a broad picture of all that is being done. Encyclopaedias are also needed by those who have to explain to the farmer how a discovery in plant physiology is likely to affect current agricultural practice. Encyclopaedias also help us to avoid being carried away by the over-enthusiastic claims of specialists who wish to ride their own hobby horses to the exclusion of all others. This in turn helps us to take reliable decisions concerning practical policies. Although the average farmer is not, therefore, likely to consult this particular Encyclopaedia himself, he should be happy to feel that the agricultural research workers who help him will have access to it. Meanwhile we must congratulate the contributors, editors and publishers on the very notable achievement of having produced the four excellently printed and bound, fully documented and copiously indexed volumes before us.

C.R.M.

Agricultural Chemicals Approval Scheme

Additions to the 1961 List of Approved Products

The following products have been approved under the Agricultural Chemicals Approval Scheme since the first list of Approved Products was published on 1st February, 1961. The basic list is available, free, from the Ministry (Publications), Ruskin Avenue, Kew, Richmond, Surrey, and from all Regional and Divisional Offices.

INSECTICIDES

MEVINPHOS

A systemic organo-phosphorus insecticide of rapid action and very short persistence. For control of aphids and caterpillars on field and fruit crops where rapid kill is required close to harvest.

Liquid formulations—

Phosdrin—Shell Chemical Co. Ltd.

FUNGICIDES

COPPER—*Wettable Powders*

Bugges Wetcol Oxychlor "50"—Bugge's Insecticides Ltd.

MANEB—*Wettable Powders*

American Dithane—Shell Chemical Co. Ltd.

HERBICIDES

MECOPROP—*Potassium and Sodium Salt Formulations*

Compitox
*Clovotox } May & Baker Ltd.

SEED DRESSINGS

GAMMA-BHC/ORGANO-MERCURY DRY SEED DRESSINGS

Kotam—Shell Chemical Co. Ltd.

MISCELLANEOUS

DICHLOROPROPANE-DICHLOROPROPENE MIXTURES

Liquid formulations—

P.B.I. DD—Pan Britannica Industries Ltd.

METHAM-SODIUM

A dithiocarbamate soil sterilant for the control of potato root eelworm, root knot eelworm, certain soilborne diseases and weed seedlings.

Liquid formulations—

Unifume—Universal Crop Protection Ltd.

*Products marked with an asterisk are available in small retail packs.

Seed Dressings and Risks to Wild Life

Dressings containing dieldrin, aldrin and heptachlor can kill birds that eat treated seed. Great care should be taken not to leave any treated seed lying about when it is being stored or sown. Higher strength dressings for wheat bulb fly should be used only on winter wheat and then only in areas where there is a real danger of attack. Dressings containing dieldrin, aldrin and heptachlor are not to be used at all for spring-sown grain.

THE MINISTRY'S PUBLICATIONS

Since the list published in the August, 1961 number of AGRICULTURE (p. 274), the following publications have been issued.

MAJOR PUBLICATIONS

Copies are obtainable from Government Bookshops (addresses on p. 340), from any Divisional Office of the Ministry or through any bookseller at the price quoted.

BULLETINS

No. 62. Bulb and Corm Production 5*s.* 6*d.* (by post 5*s.* 11*d.*)

The new up-to-date edition of this Bulletin covers all aspects of bulb and corm production from soil preparation and planting to lifting and storing. The more important bulbs are dealt with individually.

LEAFLETS

Up to six single copies of Advisory Leaflets may be obtained free on application to the Ministry (Publications), Ruskin Avenue, Kew, Richmond, Surrey. Copies beyond this limit must be purchased from Government Bookshops, price 3d. each (by post 5d.).

ADVISORY LEAFLETS

No. 24. Buildings for Storage of Potatoes (Revised)
No. 226. Red Spider Mite (Revised)
No. 233. Beet Eelworm (Revised)
No. 335. Rootstocks for Apples and Pears (Revised)
No. 243. Commercial Varieties of Apples and Pears (Revised)
No. 351. Summer and Autumn Cabbage (Revised)
No. 376. Weed Control in Peas (Revised)
No. 395. Hay. Growing the Crop (Revised)
No. 448. Hay. Quality and Seeding (Revised)
No. 496. Caustic Soda Immersion Cleaning (New)
No. 500. Armillaria Root Rot (New)
No. 501. Winter Rye for Spring Grazing (New)

FREE ISSUES

Obtainable only from the Ministry (Publications), Ruskin Avenue, Kew, Richmond, Surrey.

At the Farmer's Service (Revised)

In Brief

SWINE FEVER SLAUGHTER POLICY

A compulsory slaughter policy in cases of swine fever was foreshadowed by the Minister of Agriculture, Fisheries and Food in a written reply to a question in the House of Commons recently.

"We have had very useful discussions with the interests concerned", said the Minister, "and preparations are going ahead for the introduction of a compulsory slaughter policy for swine fever early in the new year. The exact date will be announced later.

All diseased pigs and contacts will be slaughtered and destroyed or buried. Full value will be paid for all pigs slaughtered which show no evidence of swine fever and half value for those which are diseased at the time of slaughter.

Infected premises will be cleansed, disinfected and kept under restriction for 14 days before restocking is allowed.

In order to keep the incidence of swine fever as low as possible, infected area restrictions will be imposed where necessary, but in the case of isolated outbreaks the immediate premises only will be put under restrictions.

Vaccination with crystal violet vaccine will be allowed in the earlier stages of the Scheme, but policy on this point will have to be reconsidered in later stages.

We will watch carefully the progress of this Scheme and our hope is that, in a few years, it will lead to the stamping out of swine fever in Great Britain."

MEASUREMENT OF TEMPERATURE IN BULK GRAIN STORES AND BULK POTATO STORES

The development of new methods of storing grain and potatoes has led on many farms to a need for checking of temperature of the stored product. On most small farms this can be done by cheap and simple equipment. For example, a $\frac{3}{8}$-inch diameter steel rod thrust into each grain bin in such a way that it can easily be withdrawn and run through the hand can provide a rough indication of the development of heating to the farmer who is prepared to climb up and check carefully and regularly. Similarly, simple mercury-in-glass thermometers dropped down lengths of plastic pipe on the end of a piece of string can serve for checking temperatures in bulk potato stores. Many farmers, however, seek easier and more accurate methods, and have so much produce stored that a reasonable expenditure on more advanced temperature measuring equipment can be justified. For these, firms specializing in instrumentation offer distant-reading electrical resistance thermometers which make it very easy and quick for the farmer to check and keep a record of temperatures at a number of points in the installation.

In a typical system, the changes in electrical resistance of a nickel coil element which is buried in the produce cause variations in the current which flows through an indicating galvanometer. The galvanometer is calibrated to read off temperature in degrees Fahrenheit, and there is a system of switching which makes it easy to read off temperatures at all points wherever the resistance coils are inserted. For grain stores, one manufacturer houses the thermometer elements in a nylon tube, and in deep silos it is advisable to place an element at about each 10 feet depth.

It is, of course, important that the switch gear should be well designed to provide low and uniform electrical contact resistance. With a good installation the farmer can check temperatures at 100 or so points and write down the records in about five minutes. By this means any tendency of temperatures to change can be clearly seen, and any necessary remedial action taken at an early stage.

C. Culpin

IN BRIEF

CONDENSATION IN COWSHEDS

As every farmer knows, cows need dry beds and a warm, dry shed free from draughts. Only then will they thrive and milk well. On the small farms of the western counties in England and Wales most dairy cows are still housed in cow-houses. In these sheds under the moist atmosphere of the western coastal areas the chief enemy is condensation. It is caused by warm, moisture-laden air rising from the animals and meeting the cold surface of the roof. Slated and tiled roofs allow the moisture-laden air to escape through the joints. Large roofing sheets don't do this and condensation occurs. When it does the main reason is usually bad design or faulty construction. Many a farmer's pleasure in a new cowshed in the summer turns to dismay when he finds his cows "rained on" with condensation on the first frosty morning.

Cows radiate heat—20 will give off 20 kilowatts in an hour. That's equal to 20 one-bar electric fires. But it's not dry heat. The heat given off by one cow in one hour contains 10 points of moisture—that works out at 30 gallons a day! And when it strikes a cold surface it condenses. Good design will avoid this.

Air movement defeats condensation and ventilation creates the movement. A good cowshed will have between 500 and 600 cubic feet of air space per cow. It will maintain a temperature of around 50°F. And the air will be changed ten times per hour—without draughts.

How is this done? By outlet ventilation through the roof; and air inlets in the walls a foot below the eaves. Cool air enters without causing draughts. It is warmed by the cows, rises and goes out through the roof ventilators. Provided these are insulated there will be no condensation in them.

Condensation is no easy problem. Weather conditions, particularly in the western coastal areas, can upset the best of designs. Even with good ventilation trouble can arise in a sheeted roof and we find condensation running down the underside of the sheets, on to the purlins and then dripping on to the cows.

This can be overcome quite simply by using sheets 5 ft long to lap at both ends on the purlins which are spaced 4 ft apart. Put a washer between the sheets where they overlap at each fixing bolt. This will create a small gap between the sheets above each purlin. This gap is an aid to roof ventilation. It causes a slight current of air to move up the underside of the sheets from eaves to ridge. It also allows any condensation to pass from the underside of the roof to the outside and so into the rain-water gutters instead of inside the shed. Many farmers who have adopted this technique have proved its worth.

Have you got a condensation problem? Are you thinking of a new cowshed? In either case the Agricultural Land Service can help you. Get in touch with the Land Commissioner at the Divisional Office of the Ministry of Agriculture, Fisheries and Food.

G. A. Young

LIGHT ON VEAL CALF PRODUCTION

Veal calf production has come in for criticism from some quarters because of a belief that it is necessary to keep the calves in the dark and to create an anaemic condition in order to produce white flesh. But trials at J. Bibby & Sons' Nutrition Research and Advisory Station at Weatherstones in North Cheshire indicate that neither of these controversial methods is necessary. There is no point in keeping these calves in the dark, say the Weatherstones scientists, for while darkness can reduce a calf's activity to a minor extent, it has no effect on the appearance of the flesh. Indeed, the house used for veal calf trials at Weatherstones is well-lit, warm and dry, with individual pens of a reasonable size—pleasant enough conditions for any animal.

As far as anaemia is concerned, Dr. R. Roberts, the Chief Biochemist, feels that the major influence on flesh colour is the method of slaughter. The efficiency of bleeding after the calf has been killed has far more influence on flesh colour than any degree of anaemia in life—white meat is produced from the pig, for example, by the method of cutting and bleeding after electrical stunning.

MANURING OF VEGETABLES

Experimental data on the manuring of vegetables is scanty and Potash Ltd., in their recent booklet, *Manuring of Vegetables*, aim at providing a guide for farmers on the use of fertilizers, and in particular potash, for vegetable crops. But they have in general been content to outline the methods used in good commercial practice. In this they have followed closely the recommendations made in Ministry of Agriculture Bulletin No. 71, *Soils and Manures for Vegetables*, which appeared in 1959.

The first part of the booklet is devoted to a discussion of the value and functions of potash in relation to vegetables. Although there is perhaps some occasional over-emphasis, e.g., as in relation to the production of "blowers" in Brussels sprouts (probably more often due to loose soil at planting than to unbalanced manuring), the publication in general gives a well-balanced account of the subject.

The basis of potash manuring is shown to depend on the crop, the type of soil and the policy of the farm in respect of organic manures. It is pointed out that light soils, often naturally poorly supplied with potash, are widely used for vegetable growing and may require supplementary dressings. These soils also have a high organic matter requirement which may have to be met by growing leys or by the use of organic manures, many of which have low potash contents. The composition of a range of organic manures and fertilizers is given to support this viewpoint.

In the section on fertilizer recommendations, it is encouraging to see nutrient requirements expressed in units of plant food as well as in terms of "straight" and compound fertilizers. Units give an easily understood means of expressing fertilizer needs which is being increasingly used by farmers and advisers. There is a realistic approach to the use of compound fertilizers, and the need to use a limited number of types on a particular farm, approximating to the recommended dressing where necessary, is recognized.

The actual advice given for the wide range of vegetable crops dealt with is sound, and as much detail as possible is given in the space available. Where there is experimental evidence, such as for winter celery, it has been used, although there is a danger in giving general advice on the basis of trials carried out in only one area. The autumn use of farmyard manure and reduced yields due to nitrogen are well established by experiment on fen peats but in the north, on moss peats, nitrogen often gives good results, and farmyard manure is nearly always applied in spring for celery. Errors of this kind are a result of the limited amount of experimental work which has been carried out on vegetable crops grown on commercial holdings and will be less likely to occur as the gaps in our knowledge are filled.

The booklet, which is well produced, can be obtained from Potash Ltd., Norfolk House, St. James's Square, London, S.W.1.

J. J. Webber

Book Reviews

Weeds and Aliens. Sir Edward Salisbury. Collins. 30*s*.

How easy it would have been for Sir Edward Salisbury to have prepared a "Weed Killer's *Vade Mecum*", and how well it might have been received at this time, when there is such enthusiasm for killing weeds by chemical means. Those of us who share his interest in plants, native or introduced, legitimate or misplaced, will be grateful that he has chosen instead the botanist's way of telling their story.

At the outset he makes it clear that weeds, though familiar enough, merit study because of their success in the struggle for existence. He shows that much is to be learned from a knowledge of how they secure their share of sunlight and exploit the soil for moisture and nutrients, sometimes to the disadvantage of crop plants. Some species accumulate in their tissues micro-elements essential to plant and animal health, cobalt and copper, manganese and magnesium, and it is suggested that because of this their presence in fodder and in compost may well be justified.

Of course much depends on our definition of a weed. The author states that a weed is a plant possessing certain aggressive qualities, growing where it is not wanted and then defying easy control. That is fairly apt, though some may still like the older botanist's definition that a weed is a plant whose virtues are not fully understood and appreciated. Essentially such plants are weeds only in their association with man and his activities, and it is in this context that their method and rate of reproduction, their means of dispersal and persistence in exploiting new and unexpected environments are so important.

Here, in this New Naturalist volume, are new studies of old inhabitants of the British Isles, plants well known to the Elizabethan botanists Gerard and Parkinson, besides details of some aliens, like the cape cowslip or yellow oxalis from South Africa, now a nuisance in the bulb fields of the Isles of Scilly.

The author gives good general descriptions of many of the species he discusses and often includes details that he himself has collected on their method of perennation or of their reproductive capacity, frequently supplementing these with his own drawings and photographs.

An important chapter deals with the principles of control by herbicides, chemical substances whose limitations the author rightly points out. There are a good bibliography and a full index.

The last paragraph in the text conveys some good advice that bears repeating:

"The importance of established agricultural practices for weed control remains. Alternate husbandry, long leys, and rotations, harrowing, hoeing and stubble cleaning, that contribute alike to efficient farming, can materially diminish the weed population of most of the aggressive species, when applied with a due sense of their appropriate timing. They are the farmer's first line of defence against many evils whilst herbicides should be regarded as a supplement to, not a substitute for, good husbandry—whether it be on the farm or in the garden."

H.W.M.

Biological Problems arising from the Control of Pests and Diseases. Edited by R. K. S. Wood. Institute of Biology. 25*s*.

The Institute of Biology is doing a valuable service by organizing symposia on important biological topics and publishing both the papers read and the subsequent discussions. Among previous subjects have been the biology of deserts, the numbers of men and animals and the biology of ageing.

The symposium reported in this book brought together workers following various aspects of biological and medical research directed to improving the lot of man, but particularly the two topics of crop pest control and the control of disease organisms or their vectors. Both these subjects, after a triumphant start in which undesirable organisms were killed in massive quantities by relatively specific sprays or drugs, have run up against the response of the organisms to such a violent new selection pressure. Resistant strains of insects and bacteria are carrying on a constant tug-of-war against the use of new chemical weapons being directed against them.

In some ways agriculturists have had the best success because they do not have to aim at complete extermination of the pest, but only at reducing it to a level where

economic loss is tolerable. The aim of medical research is to eradicate certain diseases, and so the selection pressure they exert has to be more stringent.

This new selective atmosphere works two ways. Not only are mutant strains resistant to the new weapons fostered but, where crops or animals are deprived of experience of pest or disease organisms by their temporary elimination, they lose the degree of immunity they may have acquired. Later renewed contact may then have explosive results.

The separate papers read at this symposium deal mainly with specific lines of research on insect and virus pests of crops, and on the causative and transmitting agents of such diseases as trypanosomiasis, malaria, and yellow fever. But throughout there appear two anxieties. The first is that man's armoury of chemical weapons may ultimately fail to keep pace with the changes in the noxious organisms concerned. On the whole the tentative answer is offered that a new balance must be established between organism and environment and that, to do this and prevent "plague" outbreaks, genetic and ecological diversity must be encouraged.

The second anxiety is that the more efficient production of food and the elimination of diseases are accelerating the rate of increase of man to an extent which bodes disaster. The answer given to this is not so clear. *H.N.S.*

Animal Nutrition and Veterinary Dietetics. (4th Edition). J. T. ABRAMS. W. Green and Son. 84*s*.

The new edition of this book represents a considerable achievement on the part of Dr. Abrams. He gives a scholarly exposition of the whole field of animal nutrition, from the chemistry of all the main components of feedingstuffs to the construction of rations for such widely differing species as cattle and mink. The argument is carefully documented with references to over 1,500 original papers, at least half of which have appeared since 1950. Nothing comparable is published in the United States, so we are doubly fortunate in having the standard work on the subject, with its examples based firmly on conditions in Britain.

The price of the new edition is justified by its size (826 pages), but this must of course limit its distribution largely to libraries and reference shelves, though any student who could afford a copy would certainly find it extremely useful.

Dr. Abrams demonstrates the truth of his assertion that modern animal nutrition must be "the progeny of agricultural economics and biochemistry". He explains the few general principles of the subject, and then shows how these can be applied to all practical problems for the different species and for the types of feedingstuff available. There is a wealth of calculated examples for actual rations. The general framework of the book follows the earlier editions, but apart from normal expansion to bring in rapidly accumulating knowledge, an entirely new section has been added on hunger and the factors that affect the palatability of different foods.

K.J.C.

Slatted Floors for Livestock. I. J. FLEMING and J. D. CUNNINGHAM.

Slatted floors have been used for sheep in Iceland for a couple of centuries and in Norway for more than a generation. But interest in their possibilities as a general form of livestock housing is very recent and development on the Continent and in this country has been on a highly individual basis. Consequently it has been more than difficult to obtain balanced information on this technique. Fortunately, however, the Agricultural Work Study Unit of Scottish Agricultural Industries Ltd. have now produced a comprehensive booklet which summarizes in detailed advisory form the experiences of farmers and the findings of research workers on this subject. It deals mainly with slatted floors for cattle, but also includes information on floors for pigs and sheep.

Beginning with a description of the two types of slatted floor system, in one of which the dung is removed as a solid or semi-solid, in the other as a sludge, it continues with advice on stocking and management and on the design of permanent and removable floors. It ends with detailed recommendations on construction and operation and a list of the probable advantages of this method of housing. There are in addition detailed appendices on such points as the slatted floor requirements for different classes of stock. the accumulation of dung below a slatted floor, and sample costs of some of the more common materials used for building these floors. The booklet, which is well illustrated with plans and sketches, deserves particular praise for the clarity of both style and presentation.

It is indeed the best summary of available knowledge on this unfamiliar and interesting system that has so far appeared. It admirably fulfils its stated purpose of "providing a background of information for those farmers who are contemplating the adoption of this method of housing." The authors are to be congratulated on a valuable and timely publication.

Copies of the booklet, which is referenced as SAI-AWS-8, are obtainable free on application to the Agricultural Work Study Unit, Scottish Agricultural Industries Ltd, 39 Palmerston Place, Edinburgh, 12.

N.H.

A Bibliography of Farm Buildings Research 1945-58; Part V, Buildings for the Drying and Storage of Grain. Agricultural Research Council. 3*s*. (3*s*. 6*d*. by post).

In their report for 1958-59 the Agricultural Research Council recorded their views on farm buildings research. The first step, they thought, was to make available to landowners and farm buildings advisers all knowledge at present available in the simplest and most accessible form. This they are doing most effectively, in their Bibliography of Farm Buildings Research 1945-1958, Part 5 of which has just appeared.

Dealing with buildings for the drying and storage of grain it follows the pattern of earlier parts. In it reference is made to publications that have appeared in any country where conditions are similar to those in Great Britain. In preparing it, "research" has been taken in its widest sense as any form of deliberate and critical enquiry for whose findings evidence is presented. Thus it includes scientific research in its strict sense, systematic investigation such as surveys and field trials, or similar development phases of new and experimental techniques.

As with earlier parts, a great deal of information is revealed. Never before has the designer of buildings for grain storage and drying had the sources of knowledge presented to him in one publication. The work will be valuable not only to building designers but to engineers as well. Students training for a career in agriculture should find a use for it, and their tutors should find it of even greater value.

Horticultural buildings are not included.

Because of limitations which they could not avoid, the A.R.C. make no claim to completeness in the Bibliography. Also the peculiarly fragmented subject presented many difficulties. Even so this part is just as valuable as its predecessors and should be welcome.

C.R.

Why Labour leaves the Land. International Labour Office. 13*s*. 6*d*.

The movement of people away from farming has always caused comment and, often, concern. Much has been written about it—particularly in this country, where the scale of the movement during the Industrial Revolution presented an unusual phenomenon. Beneath this social reorganization there were powerful economic forces which are now more readily understood. There is a wide gap in time and mood between Oliver Goldsmith's *The Deserted Village* and *Why Labour Leaves the Land*. Both are works on the same theme, but the former is a lament from a poet who saw and wrote warmly of things he felt about, whereas the latter is factual, analytical and objective. It also spans a wider horizon than the decay of rural social life in England, being concerned with conditions in many different parts of the world.

The Report shows that incomes in agriculture are invariably below those in industry. In a developing economy with alternative opportunities for employment outside farming, farm workers are attracted by the higher incomes in industry and leave the countryside for the towns. Here we have a combination of the "push" and "pull" factors. There is the incentive of low incomes for people to leave farming: while there is the corresponding incentive of higher incomes to move into industry. These factors are complementary. Whether they operate largely depends on whether the economy of a country grows or not. In the eighteenth and nineteenth centuries they operated to such an extent in this country that by the turn of the century only nine per cent of the total labour force was engaged in farming. Scope for further reduction was, of course, limited. Even so, in spite of population growth, the proportion is now only about half of what it was in 1900.

To a lesser degree, this process has accompanied industrialization throughout the world. Among highly developed

economies the agricultural labour force rarely exceeds about one-fifth of the total labour. This applies even to countries so dependent on farming for their national livelihood as New Zealand and Denmark. The same pattern is likely to come about in any lesser-developed economy beyond the "take-off" stage in its economic growth. But the important question concerns the condition of agriculture as the process of industrialization gathers momentum. Apart from social considerations, can any nation afford to have an outmoded system of farming alongside newly established industries? This Report advances strong argument to the contrary, and offers a general recommendation that economic development should not be one sided. No country can afford the luxury of a rapid growth in the industrial sector and poverty in agriculture. In any case, even where the agricultural industry is reasonably efficient, once a country can afford it, some transference of income into agriculture is likely to be necessary to make good the almost inevitable lag in agricultural incomes.

Much more is now known about the social and economic forces at work in the migration of labour from farming than when Goldsmith wrote. But it is important that the results of this additional knowledge and understanding should be applied in countries which are likely to experience the same phenomenon, probably occurring at an even greater speed. This Report is an important source of information for this purpose, being based on a thorough and comprehensive study. It is a valuable addition to the literature on the role of agriculture in economic and social development.

J.A.

Mammals in the British Isles. PHILIP STREET. Robert Hale. 21*s*.

As the title suggests, this book covers not only the wild mammals native to Britain but the domesticated breeds and those that have been introduced. Mr. Street writes for the general reader. In his introductory chapter he outlines the evolutionary history of mammals, summarizes the main features of each Order represented in Britain, and explains how climatic, geological, and historical events have influenced our fauna. There are seven chapters on wild mammals, and the author reviews possible links between wild species and domesticated stock and the methods which have led to the development of modern breeds of cattle, pigs, sheep and goats. The reverse process is described in the fascinating story of the resurrection of the aurochs by the Heck brothers. The ancestry and development of the various breeds of horses, cats and dogs are also discussed, and there is a final chapter on the breeding of mammals for their fur.

The illustrations have been chosen with care. Particularly pleasing are the compositions of long-tailed fieldmice (Jane Burton) and of fallow deer (Geoffrey Kinns); these and other pictures of their kind are a welcome change after a surfeit of studio portraits.

The author has omitted to give a bibliography, feeling that this would serve little purpose. Although he claims that he has "given the names of zoologists and naturalists who have been responsible for recent advances in our knowledge in appropriate places in the text" he mentions only some half-dozen. It is curious to read four and a half pages on *Glis glis* (cited on the dust cover as one of the notable features of the book) which are composed entirely of facts given in Mr. H. V. Thompson's paper on this species, and to find that although the paper is quoted, the author is not.

In his account of rat control, Mr. Street neglects to mention the changed techniques used since the development of anticoagulants. Perhaps he underestimates the concern now felt about coypu in East Anglia; and he says nothing of the escaped mink that are reputed to have bred in the wild in Devonshire. One or two names in the text are not included in the index, and some Latin names have escaped italics.

Without doubt this will be a popular book.

M.R.V.

Joseph Ashby of Tysoe. M. K. ASHBY. Cambridge University Press. 25*s*.

Miss M. K. Ashby, that distinguished writer on rural life, has added another successful work to her list—an intriguing and excellent account of her father, Joseph.

Joseph Ashby was born in 1859, the first son of a village girl. By a subsequent marriage she had three more children and, soon left a widow, raised them all by her own efforts. Moreover she gave rise to a distinguished line of Ashbys in the agricultural field: her son Joseph, his son Professor Ashby

(C. S. Orwin's successor at the Agricultural Economics Research Institute, Oxford), the author herself and, in the third generation, Professor Ashby's son, now working in the same field.

Miss Ashby gives us a faithful picture of this so different world, and though it is done with a scholar's accuracy—the references are checked, old newspapers, parish registers and endless documents consulted—yet the result is no dry-as-dust record but a sympathetic account of a remarkable father, who must have been much loved by his children. It was a hard struggle to live in those days: little could be expected from what today we call "the establishment"—the church and the big houses—for example, it even got hold of the "Town Lands", the remnant of the villagers' common fields, and distributed the income from them as charity blankets and food.

In the end it was the doctrine of self-help that secured a better life for the labourer, a course of action urged by the Victorians, though they were shocked by the results when it was put into practice. Pig clubs, Bible readings, chapel instead of church, unions, in all of which Joseph played a leading part, were the things that lead to improvements. This is a fascinating story, beautifully told and not without its moral for today.

G.O.

Suffolk: A Shell Guide. NORMAN SCARFE. Faber and Faber. 12*s.* 6*d.*

Suffolk remains rural, with little industrial invasion. Its countryside, so variable from the clays to the sands, its heaths and broken coastline, all have a particular charm, which is enriched by the many ancient churches and houses, whilst all is enshrined in both local and national history. It is with the historical approach that Norman Scarfe has set out to describe parish by parish what can be seen.

The merits of each town and village church and manorial hall are described, together with a fuller history of the larger towns such as Bury St. Edmunds, with its ruins of a once famous monastery and shrine, and Ipswich, with its busy port. Of the smaller villages, Norman Scarfe records sufficient to attract the visitor. Blythburgh's church, standing sentinel over the River Blyth, and the once-famous see of Dunwich nearby, are briefly portrayed to whet the appetite for greater knowledge. Framlingham with its great castle of the Bigods, Lavenham and Long Melford with their great towers born of the wool trade, Brandon and its isolation amidst the surrounding Breckland, East Bergholt and Flatford and Nayland by the Stour, are places still retaining the charm that attracted Constable. Similarly Woodbridge with its river and its boats evokes the shade of FitzGerald.

Apart from the guide information, I like this book for its accompanying photographs, which are not like picture postcards but shots which illustrate craft features in the changing styles over the centuries. This is an interesting and well-presented guide which can be recommended.

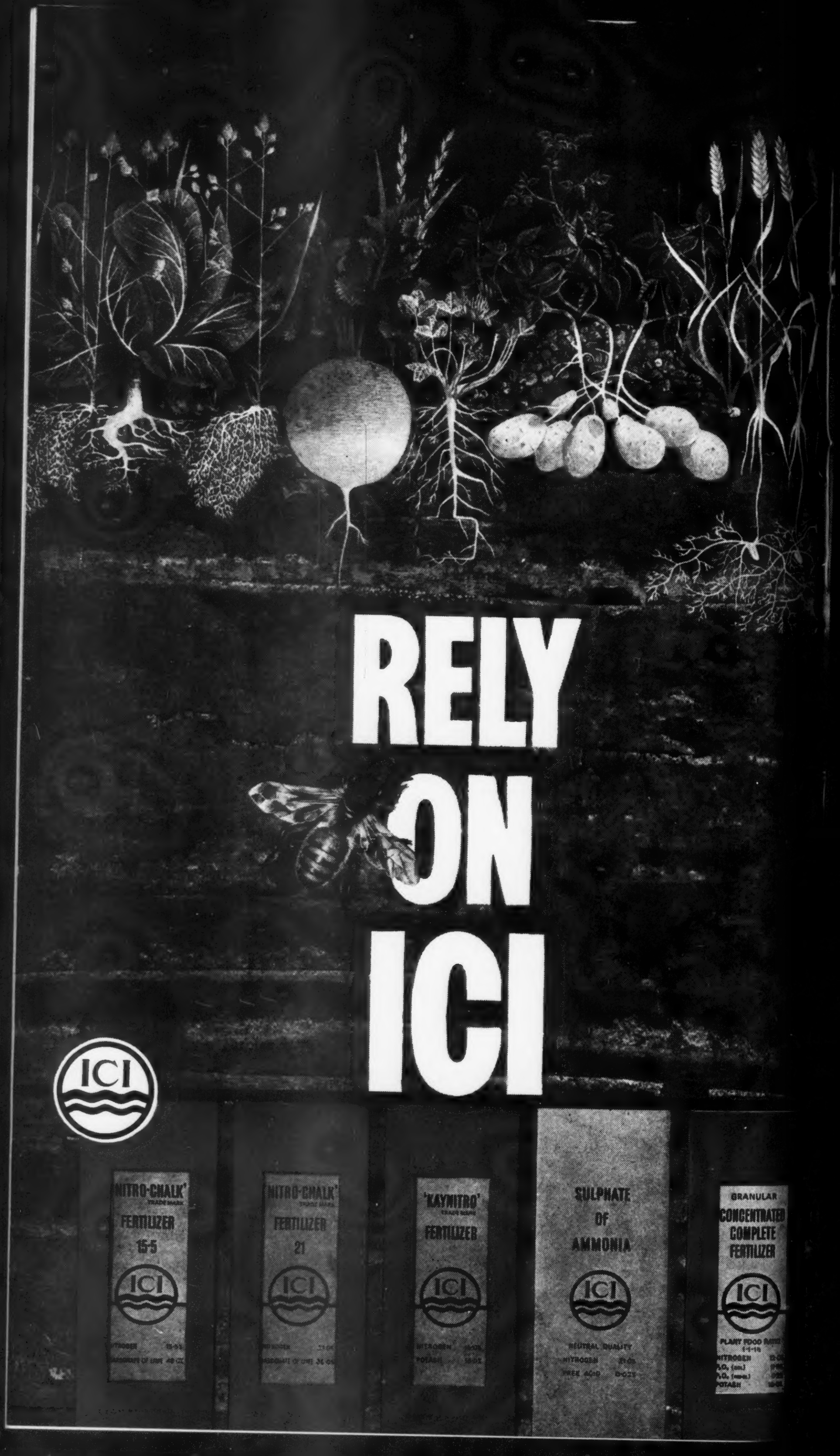
P.J.O.T.

Book Received

Annual Report of the Agricultural and Horticultural Research Station, Long Ashton, Bristol, 1960. 15*s.* (Obtainable from the Station.)

Printed in England under the authority of HER MAJESTY'S STATIONERY OFFICE
by Hull Printers Limited, Willerby, Hull, Yorks.

(K77) 72-1-61-9.



RELY ON ICI
ICI
'NITRO-CHALK' FERTILIZER 15·5
ICI
'NITRO-CHALK' FERTILIZER 21
ICI
'KAYNITRO' FERTILIZER
ICI
SULPHATE OF AMMONIA
ICI
NEUTRAL QUALITY
GRANULAR CONCENTRATED COMPLETE FERTILIZER
ICI